LTK Engineering Services

Raritan Valley Line
Capacity Expansion Study

Final Report

Prepared for:

NJ TRANSIT

By: LTK Engineering Services

in association with:

JACOBS M&S Malick & Scherer, PC

Document Number: LTK.C3954.02

February 2013

Raritan Valley Line Capacity Expansion Study

Table of Contents

0 Revision History 5

1 Executive Summary 6

1.1 Overview 6

1.2 Background 6

1.3 The Analysis 8

1.4 Environmental Issues 9

2 Existing Conditions 10

2.1 Infrastructure 10

2.2 Train Control 11

2.3 Operations 15

2.4 Ridership 17

3 Future Conditions (No Build) 19

3.1 Infrastructure 19

3.2 Operations 20

3.3 Ridership 20

4 Future Operating Concepts 21

4.1 Express Service 21

4.2 Zone Service 21

4.3 Increased Maximum Speed Service 22

5 Future Infrastructure Concepts 23

5.1 Higher Capacity Signaling 23

5.2 Third (Express) Track 24

5.3 Turnback Tracks 28

5.3.1 Westfield 29

5.3.2 Plainfield 29

5.3.3 Bound Brook 29

6 Future Operations/Infrastructure Scenarios 31

6.1 Scenario 1 (80 MPH MAS, Five Aspect Cab/No Wayside System) 31

6.2 Scenario 2 (80 MPH MAS, 3rd Track West of Westfield to Queen) 32

6.3 Scenario 3 (80 MPH MAS, 3rd Track West of Westfield to West of Plainfield) 34

6.4 Scenario 4 (80 MPH MAS, Westfield Pocket, Bound Brook 3rd Track) 36

7 Environmental Constraints 39

7.1 Current Environmental Conditions 39

7.2 Discussion of Potential Permits 40

7.3 Preliminary Screening of Scenarios 41

7.3.1 Scenario 1 41

7.3.2 Scenario 2 (Sheets 27 - 34, 40, and 41) 41

7.3.3 Scenario 3 (Sheets 24 - 34, 40, and 41) 41

7.3.4 Scenario 4 (Sheets 12-14 and 32-34) 42

8 Capital Cost Estimates 43

8.1 Overall Approach and Assumptions 43

8.2 Bridges 43

8.3 Stations 44

8.4 Communications & Signals 47

8.5 Rolling Stock 47

8.6 Summary by Scenario 47

9 Analysis of Future Operations/Infrastructure Scenarios 49

10 Conclusions and Next Steps 54

Appendix A. RVL TrainOps® Simulation Rolling Stock Inputs 57

Appendix B. Existing Signal System Minimum Headways 59

Appendix C. Conceptual Design of Five-Aspect Cab/No Wayside Signal Control Lines 72

Appendix D. RVL Additional Track Right of Way Constraints 82

Appendix E. Scenario 2 Alignment Drawings and Schematic 85

Appendix F. Scenario 3 Alignment Drawings and Schematic 95

Appendix G. Scenario 4 Alignment Drawings and Schematic 108

Appendix H. Plainfield Turnback Drawings (Not Included in Any Scenario) 120

Appendix I. RVL Environmental Constraints 123

Appendix J. Scenario 1 Time-Distance (“String”) Chart Simulation Results 141

Appendix K. Scenario 2 Time-Distance (“String”) Chart Simulation Results 144

Appendix L. Scenario 3 Time-Distance (“String”) Chart Simulation Results 147

Appendix M. Scenario 4 Time-Distance (“String”) Chart Simulation Results 150

Appendix N. Capital Cost Estimate Detail by Scenario 153

Appendix O. Future Operating Plans 168

0 Revision History

Revision No.	Date	Description of Revision
0	December 2012	Initial Release
1	January 2013	Draft final report reflecting NJT review comments
2	February 2013	Final report

1 Executive Summary

1.1 Overview

The Raritan Valley Line (RVL) Capacity Study has investigated a number of capacity enhancement options along the central segment of the RVL corridor between Cranford and Raritan. These improvements, coupled with other improvements further east in the corridor, have the potential to transform the RVL. The central segment's historic alignment and width of the right-of-way lend themselves to a future that offers more service, improved trip times and greater connectivity. NJ TRANSIT has advanced the planning for a series of projects on the eastern segment of this line involving the Lehigh Line, which is shared with the freight railroads, and the Lehigh Line's connection to the Northeast Corridor in Newark. There also have been requests to extend RVL services westward which NJ TRANSIT has studied.

For the proposed westward rail extensions to function so they achieve the ridership and other goals needed to justify the required capital investment, core system improvements must be made. In addition to investing in improvements on the eastern portion of the line noted previously, NJ TRANSIT has begun, through the RVL Capacity Study, the required planning to outline the feasibility and requirements for adding train capacity in the central segment of the RVL between Cranford and Raritan. It is expected that in the future, additional capacity (including possibly a new third track) will need to be added to support future service demands in the central segment of the RVL.

NJ TRANSIT's potential future RVL capital improvements and service enhancements require that communities along the line (including potential extensions) consider actions that facilitate transit-supporting development near RVL stations. These actions can provide synergistic benefits for communities and for transit users: more ridership brings more service and more service brings more ridership. The capital requirements and operating funding support needed for the array of potential capital improvements and service additions necessitates that every effort be made to boost future RVL ridership.

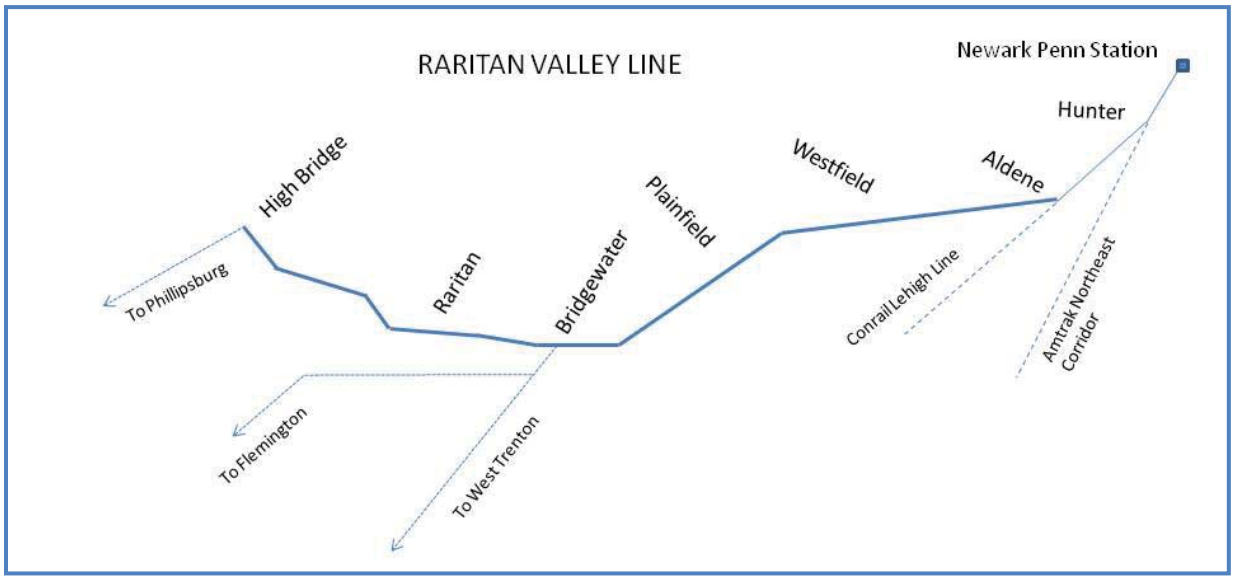
1.2 Background

The purpose of this report is to begin outlining a framework for additional analysis in order to firmly establish a future RVL Infrastructure Improvement plan. Until that is progressed further, this report provides guidance for capital improvement decision-making, especially as it relates to station platform configurations and potential funding for bringing additional RVL stations into compliance with the Americans with Disabilities Act (ADA).

This report contains an analysis of several capacity enhancement options for a 20-mile long portion of the RVL. Other capital projects are under consideration which would improve capacity for RVL trains operating on lines further east that are owned by other rail operators. To better understand the area which is the subject of this study, the following general description of the RVL is provided.

The RVL is a commuter rail line in the I-78 Corridor in north-central New Jersey that connects with other NJ TRANSIT lines at Pennsylvania (Penn) Station in Newark, NJ. RVL passengers transfer to/from other services at Newark Penn Station to reach Manhattan and other points in northern New Jersey. After departing from Newark Penn Station, outbound RVL trains operate over Amtrak's Northeast Corridor for approximately 2 miles, then operate over the Conrail Shared Assets Lehigh Line for 6 miles. At Aldene, near the common border of Roselle Borough, Roselle Park Borough and Cranford Township, trains transition to the

portion of the RVL right of way owned by NJ TRANSIT. The majority of RVL trains originate/terminate at Raritan, approximately 20 miles west of Aldene. A smaller number of weekday-only trains serve the 16-mile segment between High Bridge and Raritan; all of these trains also serve the RVL between Raritan and Newark. The line's major train storage and servicing facility is located at Raritan. The focus of this report is the central segment of the NJT-owned RVL segment of the line, between Crandford and Raritan.



The NJ TRANSIT-owned portion of the RVL consists of two main tracks, generally suitable for 80 mph operations, between Aldene and Raritan. A single main track (with two passing sidings) is in place between Raritan and High Bridge, with a maximum authorized speed of 70 mph. The RVL service is provided with diesel locomotives and multilevel coaches. RVL 2012 ridership was about 21,800 passenger trips (both directions combined) per weekday. This represents about 7.8% of total NJ TRANSIT Commuter Rail ridership. Currently there are 53 trains each weekday and 37 trains on weekend days.

NJ TRANSIT has studied numerous alternatives for extending RVL service westward, either to points along the historic RVL corridor (such as Phillipsburg), or on lines which would branch from the RVL at Bridgewater and extend to either Flemington or West Trenton. NJ TRANSIT is not currently in a position to advance further development of these extensions. Additional effort is also required to update and expand the planning process for these projects. However, planning studies for these extension projects indicates the need to preserve space on the central segment of the RVL system (Cranford to Raritan) to accommodate future RVL service extensions requiring added train capacity as well as to carry future core area riders on the RVL.

Approximately 60% of current RVL ridership boards at stations Plainfield and east, and this percentage is not expected to change significantly in the near future. There are also other train service operating considerations which need to be further considered and accommodated, such as track capacity to accommodate reverse peak period services and

services which do not stop at every existing station. Train trip times are a factor which influences the number of travelers who would find future services sufficiently attractive to use them. For all of these reasons, NJ TRANSIT has investigated a range of capacity enhancement options for the central segment of the NJ TRANSIT-owned segment of the RVL, as presented in this report.

1.3 The Analysis

An important starting assumption for this work effort is that sufficient capacity improvements have been made to the non-NJ TRANSIT line segments (Lehigh Line and Northeast Corridor Line) used by RVL trains to access Newark Penn Station. Some of the potential improvement projects in this territory could include Hunter Flyover, additional trackage on the Conrail Lehigh Line, and improvements to the Aldene connecting track. All of these improvements would be complex and pose significant future funding challenges.

This analysis does not assume that any new Trans-Hudson capacity has been put in place. The operating plans utilized in this analysis do not assume direct service to Penn Station New York. It is anticipated that further analysis of the central segment of the RVL will occur in the future as the planning for the different extensions progress and more is known about future available capacity on the Northeast Corridor.

This report analyzes the current RVL signal system and the operating capacity it supports. It provides a first look at enhanced service patterns and how each would relate to a variety of signal and rail network infrastructure changes including:

- Scenario 1: Signal System upgrading (shorter blocks/greater number of signal aspects)
- Scenario 2: Addition of a segment of third main track from west of Westfield to east of Plainfield (less than 3 miles)
- Scenario 3: Addition of a segment of third main track from west of Westfield to west of Plainfield (about 4 miles)
- Scenario 4: Creation of turn-back tracks to support a zone concept of operations.

Most of the scenarios – those that add a third express track and those that retain the two-track configuration – have operational benefits but Scenario 2 was found to produce unacceptable delay conditions and has been deemed “not viable” due to the relatively short length of its overtake (third) track.

All study scenarios include higher capacity re-signaling between Aldene and Raritan. Such signaling would convert the RVL to cab/no wayside train control, with five cab signal aspects (Maximum Speed, 60 mph, 45 mph, 30 mph and Restricted Speed) and shorter signal blocks providing improved following move headways. Such re-signaling would reduce the current minimum following headway of about 8 minutes (7.5 trains per hour) for an all-stops train to about 6 minutes (10 trains per hour).

The study team employed an automated Train Performance Calculator (TPC) / String Chart approach in concert with NJ TRANSIT Rail Service Planning to develop workable operating plans for each of the scenarios, varying stopping patterns, turnback locations and overtake locations. In the end, each scenario has its own operating plan with train schedules tailored to available infrastructure of that specific scenario.

The study team concluded, based on the analysis conducted to date, that Scenarios 1,3 and 4 are all potentially viable alternatives that should be considered in any future RVL capacity studies.

1.4 Environmental Issues

Using information readily available from the environmental data layers in Geographic Information Systems (GIS), known environmental issues in and around the areas proposed for capital improvements in each of the study scenarios have been screened. The screening reveals environmental sensitivities in several areas, including:

- Wetlands adjacent to the right-of-way southwest of Somerville, east of Bridgewater through Bound Brook, and east of Middlesex Borough along the Bound Brook;
- Contaminated sites in the vicinity of the right-of-way at American Cyanamid in Bridgewater; and
- Floodplains adjacency and crossings of the 100-year floodplains of the Raritan River (throughout the Raritan/Bridgewater area) and the Rahway River (Cranford).

With the exception of the Scenario 4 turnback track and expanded platform at Bound Brook, none of the identified environmental sensitivities are near the proposed infrastructure of any of the RVL scenarios examined in this study.

In addition, it should be noted that historic properties and districts located throughout the RVL may be contributing resources to the line's designation as part of the Central Railroad of New Jersey Historic Rail Corridor. Examples include station structures at Somerville, Westfield, and Cranford.

Scenario 1 has no natural resource impacts or potential regulatory permit requirements as this scenario involves changes to the signal system only.

Scenarios 2 and 3 may require a Flood Hazard Area and Wetland Transition Area permit for project impacts associated with an un-mapped stream/linear wetland that runs parallel to the right-of-way at approximately Milepost 21. Floodplains associated with the Green Brook, Cedar Brook, and Ash Brook exist adjacent to the right-of-way. Known contaminated sites exist adjacent to the project right-of-way in both scenarios. Further investigation of theses identified sites is recommended.

Scenario 4 may require a Flood Hazard Area and Wetland Transition Area permit for project impacts associated with the Middle Brook, Raritan River, and Bound Brook. These waterbodies either cross or are adjacent to the project right-of-way. Known contaminated sites exist adjacent to the project right-of-way in Scenario 4. Further investigation of theses identified sites is recommended.

2 Existing Conditions

The RVL dates to the 1840s and was operated for more than 125 years by the Central Railroad of New Jersey (CNJ). With strong commuter ridership from Raritan and points east, it operated eastward from Cranford through Elizabeth and Bayonne to the Jersey City waterfront. There, in what is now Liberty State Park, the RVL terminated at Jersey City Terminal where ferry connections could be made to Lower Manhattan.

In addition to commuter service, the CNJ operated intercity service to Bethlehem, Allentown, and Scranton, PA on its mainline, now known as the RVL. During the 1960s, passenger rail service declined and the CNJ sought an alternative to operating its costly Jersey City terminal and trans-Hudson ferry service. The "Aldene Plan" was launched, including construction of a single track connection from the RVL to the Lehigh Valley Railroad's mainline at Aldene. Use of the Lehigh Line (then operating with a significantly smaller volume of freight trains than operate today) provided access to the Hunter Connection to the Northeast Corridor, with RVL service realigned to terminate at Newark Penn Station (where connections could be made to PATH and New York-bound trains operated by the Pennsylvania Railroad). The Aldene Plan included a shuttle service from the new through Raritan-Newark route at Cranford, providing continued passenger rail access to Elizabeth and Bayonne. The Aldene Connection was inaugurated in April 1967, thereby establishing the RVL route structure that endures today.

At Cranford, the Aldene Plan produced a unique six-track configuration with two inside express tracks and four outside local tracks with island platform access on each side. The extreme outer tracks provided access to the CNJ Main Line to Elizabeth and Bayonne for shuttle train operation while the inner local tracks provided access to the Aldene Connection and service to Newark Penn Station.

In 1976, the bankrupt CNJ became part of Conrail, which operated passenger service under contract with the New Jersey Department of Transportation. The shuttle operation between Cranford and Bayonne ended in 1978. NJ TRANSIT assumed RVL operation in 1983. Under NJ TRANSIT, the line's rolling stock has been replaced, stations upgraded and the track layout reduced to two mainline tracks from the historical four track configuration.

2.1 Infrastructure

The two-track RVL extends some 21.1 miles from the Lehigh Line Connection at CP-Aldene to the end of mainline double track at Boyd Interlocking, just west of Raritan Station. The line supports an [redacted]mph passenger train maximum speed with only a few permanent speed restrictions:

- MP 15.0 to 15.9 near Aldene – [redacted]mph,
- MP 28.8 to 28.5 between Dunellen and Bound Brook – [redacted] mph (eastward, head end only through Cedar Avenue grade crossing),
- MP 34.4 to 34.6 near Somerville – [redacted] mph, and
- MP 35.1 to 35.6 near Raritan – [redacted] mph on Track 1 and [redacted] mph on Track 2.

Freight trains are limited to [redacted]mph on the line, with a [redacted] mph restriction between MP 15.0 and 15.9 near Aldene. NJ TRANSIT Timetable Special Instructions limit freight trains with

more than 40 cars to [redacted]mph maximum on the entire line, due to signal design safe braking distance constraints.

The RVL's infrastructure was extensively rationalized and rebuilt in a project that spanned the first two years of NJ TRANSIT operation, 1983 to 1985. In general, NJT retained the two RVL tracks on the inner (former express track) railbeds, leaving the outer railbeds unused. Where undergrade bridges exist, all four bridge spans were generally maintained. While there are exceptions, bridge rehabilitation projects since the rationalization have generally addressed all four spans at a given location.

The RVL has few highway/rail grade crossings between Aldene and Raritan thanks to many CNJ grade separation projects in the 20th Century. These grade separation projects spanned some five decades, starting in 1912 (in Somerville) and ending in 1954 (in Dunellen). The RVL has the following public crossings at grade between Aldene and Raritan (the last one being just west of Raritan Station):

- Mountain Ave., Middlesex (MP 28.0),
- Cedar Ave., Middlesex (MP 28.5),
- Vosseler Ave., Bound Brook (MP 30.7),
- Lamont Ave., Bound Brook (MP 31.0),
- STS Drive, Bridgewater (MP 31.2),
- Polhemus Lane, Bridgewater (MP 32.1),
- Egan's Crossing, Manville (MP 33.4),
- Thompson St., Raritan (MP 35.8), and
- Anderson St., Raritan (MP 35.9).

The Cedar Avenue grade crossing is the only one on the RVL that is shared with the somewhat parallel Conrail Lehigh Line. The Raritan Valley and Lehigh Lines share highway warning devices at this location because of the short distance between parallel rail lines.

The study territory of Raritan to CP-Aldene (just east of Cranford) includes 11 passenger rail stations. Of these stations, four (Somerville, Plainfield, Westfield and Cranford) are fully accessible, in compliance with the Americans with Disabilities Act (ADA).

2.2 Train Control

The entire territory from CP-Aldene to Boyd Interlockings was resignalled in 1985 and is equipped with Rule 261 bidirectional signaling, including both wayside and cab signals. The line features universal interlockings at Clark (which also serves as the connection to the Garwood Industrial Track), Queen (in Plainfield), and Brook (which also serves as the connection to the Conrail Lehigh Line in Bound Brook). Interlocked holding signals to support mainline train turnbacks are in service at CP (Control Point) Scotch (Westfield Station) and at CP Plain (Plainfield Station).

The Study Team performed an analysis of RVL signal design speeds, shown in Table 1. The NJ TRANSIT signal control line plans were reviewed to determine the length of provided distance for each braking profile to a Stop or Stop & Proceed signal. Depending on location, this constitutes one or two signal blocks.

The results show that most signal control lines have been optimized for NJ TRANSIT 80 mph passenger train maximum speeds. The results also show that freight train safe braking (which uses a different set of NJ TRANSIT design criteria) is not a signal spacing constraint at any RVL location. Therefore, respacing of the existing wayside/cab signal system to be more "passenger train friendly" would yield little or no passenger train capacity benefit.

Table 1 – Raritan Valley Line Signal Design Speeds

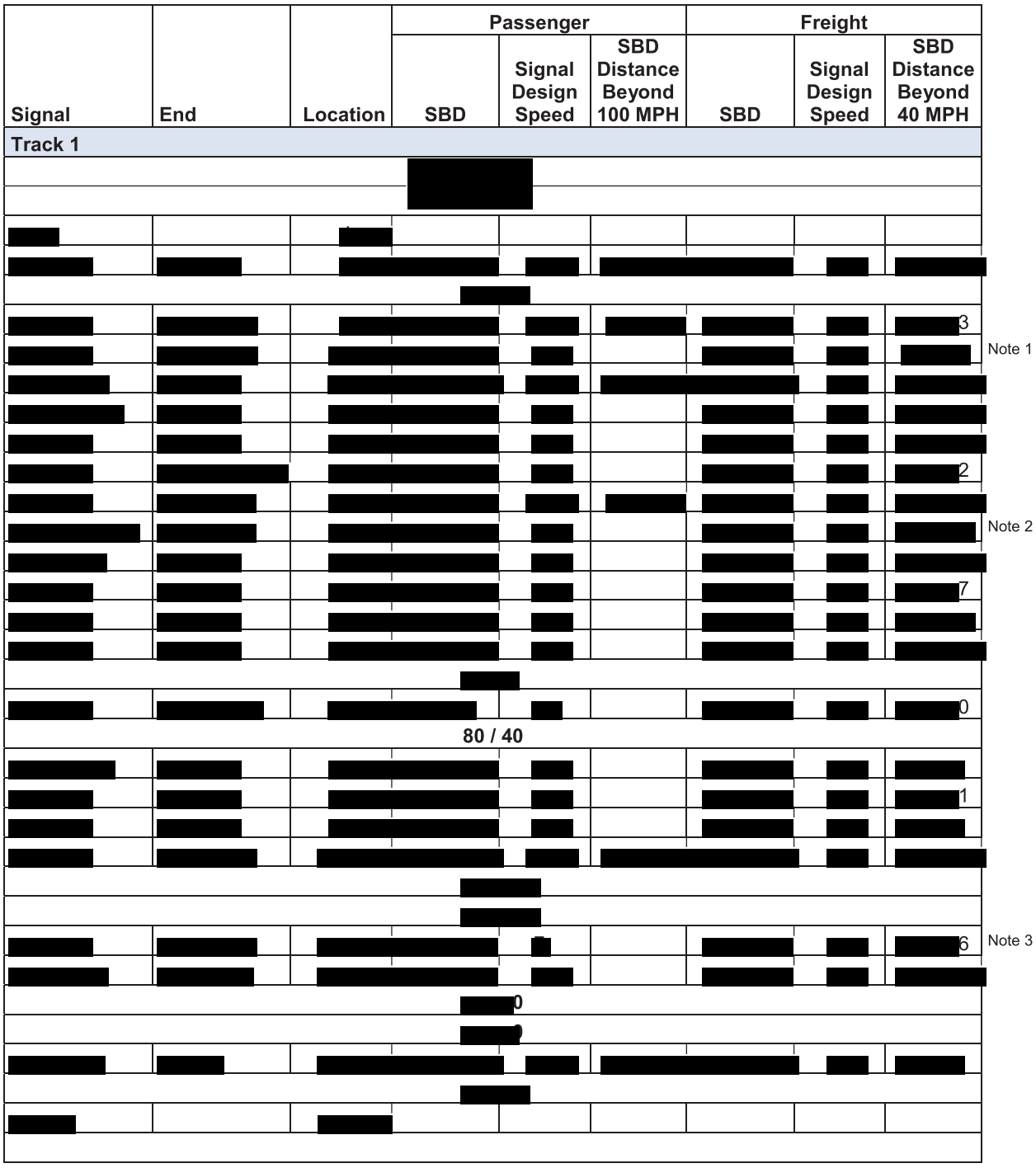


Table 1 – Raritan Valley Line Signal Design Speeds

Signal	End	Location	Passenger			Freight		
			SBD	Signal Design Speed	SBD Distance Beyond 100 MPH	SBD	Signal Design Speed	SBD Distance Beyond 40 MPH
Track 2								
[redacted]								
								Note 4

Note 1: Clear aspect signal control line at previous signal does not branch to a more restrictive aspect at this signal. Passenger train design speed requirement for Approach (previous signal at Approach Limited) is 45 mph (versus 65 mph provided)

Note 2: Clear aspect signal control line at previous signal does not branch to a more restrictive aspect at this signal. Passenger train design speed requirement for Approach (previous signal at Approach Limited) is 45 mph (versus 70 mph provided)

Note 3: Clear aspect signal control line at previous signal does not branch to a more restrictive aspect at this signal. Passenger train design speed requirement for Approach (previous signal at Approach Limited) is 45 mph (versus 70 mph provided)

Note 4: Best aspect at R156-2 with occupancy ahead is Approach (R166-2 displays Approach Limited). Passenger train design speed requirement is 45 mph (versus 55 mph provided)

It should be noted that there are four signal locations shown in Table 1 that only support 75 mph under current NJT signal design criteria (versus an 80 mph MAS). This is a common result of these types of analyses as design criteria have become more stringent in the 27 years since the signal system was placed in service.

The study team prepared a TrainOps® simulation model of actual NJ TRANSIT RVL operations and associated signal clearing times for the study. The signal clearing times define the minimum time interval between trains of identical stopping patterns on the RVL without the following train being delayed. As the study evaluated potential train overtake locations, the approximate distance that an express train must be scheduled behind a local train in two-track territory is a critical determinant of the minimum third track length for delay-free operation.

The study team used track and signal data provided by NJ TRANSIT to provide the basis for the infrastructure in the simulation model. This includes milepost distances provided in the track data; these were measured to determine distances for right-of-way infrastructure including curves, grades, station platforms, and interlocking limits. The track diagram data was also used to determine values for degree of curvature.

Signal control line ("route and aspect") data provided by NJ TRANSIT was used to determine signal locations, signal-to-signal distances and overall signal control line distances for best aspect at each signal. Employee timetables were also provided to determine the various scheduled stopping patterns. The study team used 45 second dwell times at station platforms and a 7 percent schedule margin to reflect more practical train operating conditions. The effect of the schedule margin is to derate train performance from the theoretical best case such that there is an additional 7 percent run time between stations and while dwelling at stations. No signal relay delay time or other signal-to-signal communications delay time is reflected in the results.

The preceding information was entered into the TrainOps database to simulate running times for each of the trip stopping patterns. By examining signal passing times and clearing times, the study team computed the minimum supportable headways for best aspect for each RVL signal in each direction for each scheduled stopping pattern.

The simulated RVL train included one PL42AC diesel locomotive (without dual power capability) and seven Bombardier multi-level commuter coaches (6 trailers and 1 cab car). Appendix A contains the specifications for the locomotive and coaches reflected in the simulations. Table 24 shows locomotive physical characteristics while the underlying tractive effort curve for this model is shown in Table 25. Although the maximum speed of the locomotive is 100 mph, the simulated RVL train was limited to 80 mph, consistent with the NJ TRANSIT Employee Timetable speeds for the line.

All of the simulations for the study assumed diesel performance, as opposed to "dual power" (electric and diesel) locomotive performance in diesel mode. NJ TRANSIT's ALP-45DP dual power locomotives are capable of operating in both diesel and electrified territories, including the Northeast Corridor to Penn Station New York. The performance of NJ TRANSIT's diesel only and "dual power" (in diesel mode) locomotives are very similar. Therefore, the conclusions of this study in terms of diesel locomotive-pulled trains also apply to "dual power" locomotive performance should any RVL trains be operated with ALP-45DPs.

The specifications for the coaches assumed in the simulation of each RVL train consist are shown in Table 26. Each consist has at least one Cab Control Car (Table 27), though the physical characteristics for simulation purposes are virtually identical to the coaches (without Cab Control capabilities) used. Although the maximum speed of the coaches is 125 mph, the simulated RVL train was limited to 80 mph, consistent with the NJ TRANSIT Employee Timetable speeds for the line.

By using 45 second dwells and 7 percent schedule margin, the study team found that the most constraining signal clearing time for all-stops RVL trains is about 8 minutes for best aspect. When the industry standard "theoretical to practical" additional clearing time factor of 25% (1.25 multiplier) is added, this equates to a 10 minute minimum supportable train spacing for scheduling purposes. This is equivalent to 6 trains per hour, which is what NJ TRANSIT presently schedules in the peak hour (refer to Section 2.3 for information on the 6 trains scheduled to depart Raritan eastbound between 6:19 and 7:18 a.m.)

These times are relatively long by industry standards for commuter rail operations and reflect the preponderance of four-aspect, three-block control lines and relatively long signal-to-signal distances within the project limits. Though there are no Raritan to Newark non-stop trains scheduled today, this operating pattern was also tested in simulation. The results show signal clearing times of about 4 minutes for best aspect in each direction. This, in essence, represents the "best case" signal clearing times on the RVL as it exists today.

The existing signal system minimum headway reports can be found in Appendix B.

2.3 Operations

Table 2 summarizes weekday and weekend operations on the RVL. The two-track territory from Aldene to Raritan see 25 trips each way on weekdays, including one morning peak "short turn" at Plainfield.

Table 2 – RVL Service Levels (October 14, 2012 Timetable)

Eastward	Raritan – Newark	Raritan – Hoboken	High Bridge – Newark	Plainfield – Newark
Weekday	18	1	7[1]	1
Saturdays/Sundays/Holidays	18	0	0	0
Westward	**Newark – Raritan**	**Hoboken – Raritan**	**Newark – High Bridge**	**Newark – Plainfield**
Weekday	15	1[2]	10[3]	1[4]
Saturdays/Sundays/Holidays	18[5]	0	0	0

Note 1: Six additional non-revenue trips, all operating in the evening, High Bridge to Raritan.
Note 2: Non-Revenue Hoboken-Newark.
Note 3: Three additional non-revenue trips, all operating in the early morning, Raritan to High Bridge.
Note 4: Non-Revenue.
Note 5: One additional trip on Saturdays.

West of Raritan, the RVL extension to High Bridge sees 13 weekday round trips, including a mix of revenue and non-revenue ("deadhead") passenger train movements. Eastbound revenue service is primarily concentrated in the morning peak; six of the 13 trips are late evening non-revenue moves from High Bridge to Raritan Yard. Westbound movements

consist of three early morning non-revenue “starts” from Raritan Yard to High Bridge and 10 revenue movements over the course of the day, with most service concentrated in the evening. There is no weekend service west of Raritan.

During peak periods, RVL service features zone express type service with some trains skipping some lower ridership stations. The peak period, peak direction stopping patterns are shown below with each black bar representing a train trip and each white dot representing a station stop. Scheduled times at High Bridge (where applicable), Raritan and Newark Penn Station are shown for each scheduled train trip immediately below the applicable black bar. Stations between Raritan and High Bridge are not shown in the diagrams as all revenue trains west of Raritan make all stops.

Table 3 – RVL Eastward AM Peak Stopping Pattern
(Departing Raritan 5:30 – 9:00 AM, October 2012 Timetable)

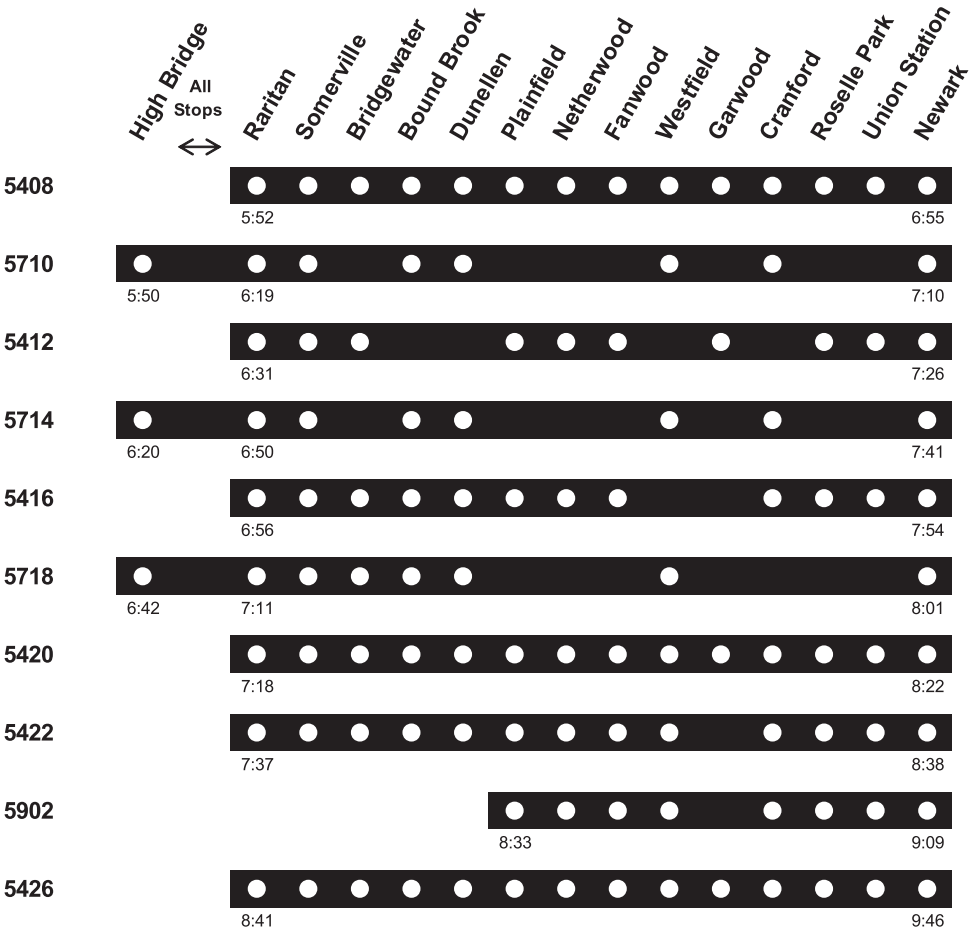
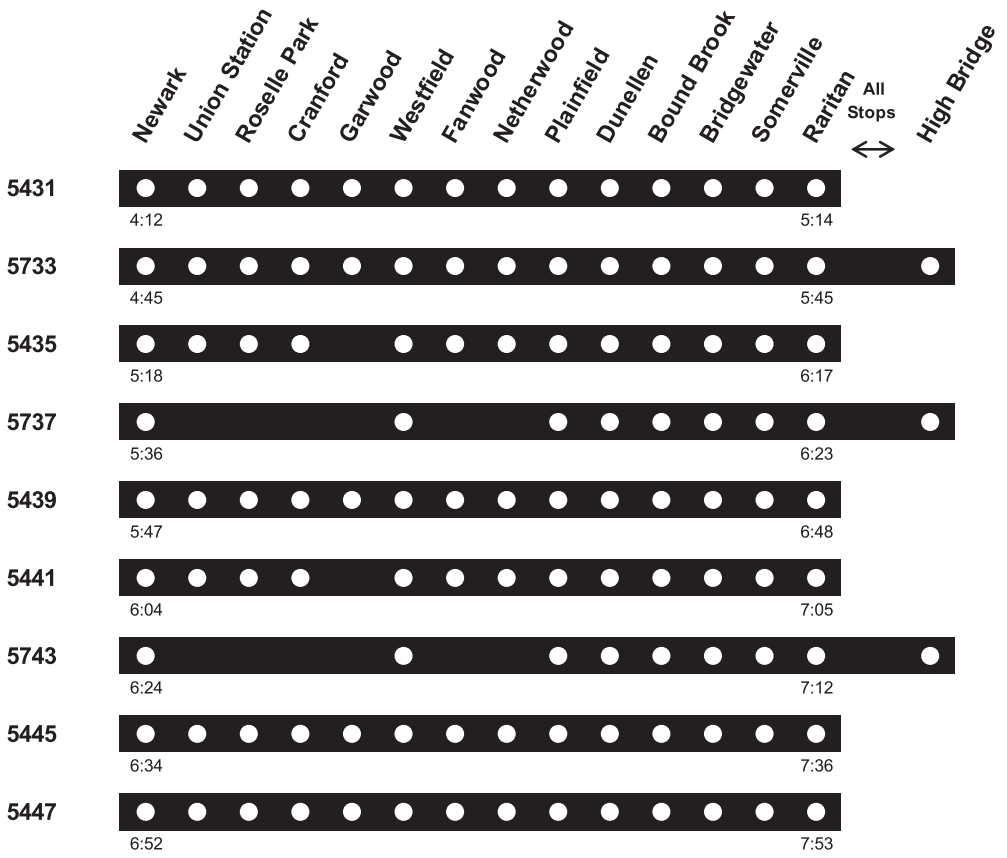


Table 4 – RVL Westward PM Peak Stopping Pattern
(Departing Newark 4:00 – 7:00 PM, October 2012 Timetable)



Freight operations on the RVL, consisting solely of local trains, are handled by Norfolk Southern (NS) for customers west of Bound Brook and by Conrail Shared Assets for customers east of Bound Brook . The two freight railroads access the RVL from the Conrail Shared Assets connection at Bound Brook. Norfolk Southern serves the line several days per week. Conrail movements on the RVL over the last year have been rare.

On very rare occasions, the line has accommodated detouring NS and CSX trains between Aldene and Bound Brook due to an unplanned outage of the Lehigh Line between these two points. The RVL cannot accommodate double stack container trains so only a small percentage of Lehigh Line freight traffic is eligible for detour.

2.4 Ridership

Average 2012 weekday RVL boarding ridership is shown in Table 5, with a one-way RVL ridership total of 11,911. Newark Penn Station (where many passengers transfer to PATH for trips to lower Manhattan) is the largest destination with approximately 5,594 of the 11,911 daily RVL passengers leaving the NJ TRANSIT system there. Penn Station New York, accessible only via transfer between NJ TRANSIT trains at Newark, is the second largest destination with 4,124 daily passengers. Hoboken ranks a distant third in RVL ridership, with 158 average weekday passengers.

In addition to the three large destination markets, about 2,035 of the daily RVL boarding passengers are destined for other locations, including stations on the line (Union Station being the largest destination).

Table 5 – 2012 RVL Average Weekday Passenger Boardings

Boarding Station	Average Weekday Boardings
Union	1,355
Roselle Park	845
Cranford	1,264
Garwood	83
Westfield	2,376
Fanwood	974
Netherwood	546
Plainfield	893
Dunellen	945
Bound Brook	622
Bridgewater	336
Somerville	677
Raritan	638
North Branch	72
White House	110
Lebanon	21
Annandale	82
High Bridge	72
Total	**11,911**

Table 5 shows that Westfield has, by far, the highest boarding passenger volume of any station on the RVL. Union Station ranks second and Cranford ranks third. Union Station, opened in 2003, is somewhat unusual in that it is located close to major trip destinations including Kean University and the Schering Plough Corporation. The station, therefore serves as both a ridership origination and destination during the morning peak period.

One-way Saturday ridership on the RVL totaled about 2,475 passengers per day in 2012 – about one quarter of weekday ridership. Sunday ridership on the RVL totaled about 1,725 passengers per day in 2012.

After several years of modest ridership declines (ridership having peaked in 2008) due to the general economic downturn and associated service cutbacks, RVL ridership between Union and Raritan showed strong growth in 2012. West of Raritan, ridership at North Branch, White House, Lebanon, Annandale, and High Bridge continued a downward trend in 2012 due to reductions in train frequencies and elimination of some express service.

3 Future Conditions (No Build)

The future “no build” scenario serves as a benchmark against which to compare the benefits of more ambitious “build” scenarios. The future “no build” Scenario includes only committed capital improvement projects and planned operational changes.

3.1 Infrastructure

The study team was directed to assume significant capacity improvements between the Aldene Connection (where the RVL meets the Conrail Lehigh Line) and Newark as part of the development of the future “no build’ scenario. These projects effectively eliminate most capacity constraints east of Aldene and this is assumed to occur prior to implementation of the most significant Aldene-Raritan capacity enhancements. The assumed capital projects east of Aldene include some combination of the following projects:

- Double track Aldene connection between the RVL and the Conrail Shared Assets Lehigh Line,
- Lehigh Line capacity improvements including additional main trackage between CP-Newark (formerly “NK”) and Aldene (a third track; NJ TRANSIT and its freight partners have discussed the possibility of a partial or full fourth track as well),
- Hunter Flyover, providing grade-separated access from the RVL Hunter Connection to NEC Track 1,
- Westbound Newark-Waterfront Connection to eliminate at-grade conflicts at the east end of Newark Penn Station (Dock Interlocking) associated with the use of Hudson Yard and the Hudson Pocket Track for turning RVL trains.

It should be noted that modest RVL service expansions may be feasible without the above capacity improvements east of Aldene. As NJ TRANSIT develops an RVL Master Plan, the interrelationship of capacity enhancements east and west of Aldene must be carefully assessed in terms of supportable service increases. Recent NJ TRANSIT studies have investigated the feasibility of three different RVL service expansions on the west end – west of High Bridge, a branch to Flemington and an extensive service expansion via the CSX Trenton Line to West Trenton. In terms of overall RVL capacity, these three service expansions are mutually exclusive due to limited available train operating slots between Cranford and Newark (east of the central segment of the RVL). The future “no build” scenario of the RVL Capacity Expansion Study did not assume that any of these three projects would be operational. As was noted in the study’s Executive Summary, additional capacity (including possibly a new third track) will likely be required in the RVL central segment between Cranford and Raritan to support future service demands resulting from service expansion to the west.

No specific RVL station projects, resignaling or track reconfiguration projects are assumed as part of the study’s future “no build” scenario.

It is recognized that additional yard capacity at the western end of the RVL will be required to support future service growth. No specific yard projects are assumed as part of the future “no build” scenario. The future scenarios – both “no build” and “build” – were not specifically constrained by yard capacity.

3.2 Operations

No changes in RVL operations are assumed in the future “no build” scenario.

3.3 Ridership

NJ TRANSIT provided representative future (2020) morning peak RVL ridership, sub-divided into groups of adjacent stations -- West of Raritan, Raritan to Dunellen, Plainfield-Westfield and Garwood-Union, shown in Table 6. While the forecasts are based on the two-hour morning peak period, the future ridership increases, in percentage terms, can also be applied to the traditional four-hour morning peak period. The base forecast reflects RVL 2010 operations, prior to the recent service cuts.

NJ TRANSIT Ridership Forecasters have noted that the RVL ridership, while constrained by lack of housing growth along the RVL, is increasingly focused on Newark and New York destinations. In essence, NJ TRANSIT has noted the trend of ridership substitution, with home turnover (resulting from retirements and occupants moving out of the area) along the line yielding a higher percentage of New York/Newark commuters than in the past. This is largely driven by relatively affordable home prices along the inner zones of RVL and relatively short commutation times from those stations to higher income positions in Newark and Manhattan.

Table 6 – NJ TRANSIT RVL Representative Future Ridership Forecasts

	7-9 AM Peak Period Riders Base 2010 (Estimated)	Representative Future Ridership Forecast (Percent Change Versus Base)
West of Raritan	[redacted]	[redacted]
Raritan-Dunellen		
Plainfield-Westfield		
Garwood-Union		
TOTAL RVL		

The future forecast with added service is based on restoration of the 2010 service cuts, essentially reverting to 2008 service levels, but then also adding service to Hoboken (3-4 trains in the two-hour morning peak period) with more express service and to Newark (2 trains in the two-hour morning peak period).

The NJ TRANSIT ridership forecasts show that RVL train capacity expansion should be able to accommodate most of the forecast growth over the next seven years. While NJ TRANSIT is already operating the maximum supportable peak hour train volume of 6 trains per hour (refer to Section 2.3), existing RVL trains can be expanded to 8 Multilevel coaches with a capacity of about 1000 passengers. Assuming uniform ridership over the entire morning peak hour, this represents a capacity expansion of 31 percent versus the current RVL train capacity offered with nine 6-car and one 7-car trainsets (in reality, RVL ridership is not uniformly distributed over the peak hour and a 31 percent boost in passenger capacity can only be achieved with some “peak of the peak” train overcrowding). Capacity growth beyond this level will require additional peak period trips which will require some of the capacity expansion projects identified in this study.

4 Future Operating Concepts

The study team worked with NJT Rail Service Planning to develop future operating concepts for the RVL. These concepts include combinations of zone service (without overtakes) and express service (with the possibility of overtaking local service). Each operating concept provides benefits in terms of reducing trip times during peak periods when ridership is highest.

The future operating concepts feature modest growth in train trips, recognizing that significant RVL capacity growth can be achieved by lengthening existing trains. For this study, peak period, peak direction growth was capped at two trains per peak period.

4.1 Express Service

Express service signifies RVL peak direction peak period trains skipping some stations between Aldene and Raritan. Express service can operate on the same track as local trains (requiring larger intervals between trains at endpoints) or using a new express (third) track. The use of a new express track for delay-free overtakes of local trains requires some 13 minutes of travel time difference between the express train and the local train. The 13 minutes are comprised of:

- Minimum future signal system headway – express train following local train (before overtake): 6 minutes,
- Interlocking route establishment time to reset route for express train after passage of local train at start of express track: 0.5 minutes,
- Interlocking route establishment time to reset route for local train after passage of express train at end of express track: 0.5 minutes, and
- Minimum future signal system headway – local train following express train (after overtake): 6 minutes.

On the RVL, the typical travel time penalty for a station stop (versus operating non-stop through the station) is about 2.5 minutes. This includes time lost decelerating, the actual station stop and time lost accelerating back to speed. Given the desire for a 13 minute travel time difference, this implies that the express track would bypass five or more RVL stations to ensure delay-free overtakes. It should be noted that these computations do not provide any allowance for operating variability in the express train or the train being overtaken.

The concept of express train overtakes presented above “locks” the schedules of the express train and the local train being overtaken for their entire trip. With many capacity-constrained rail segments east of Aldene (including the Aldene Connection, the Lehigh Line, the Hunter Connection, the Northeast Corridor between Hunter and Newark, Newark Penn Station and Dock Interlocking east of Newark), express train overtakes constrain the ability of schedulers to individually adjust the express and local train schedules. This makes scheduling solutions to these capacity-constrained segments of the NJ TRANSIT network more difficult to implement.

4.2 Zone Service

Zone service signifies following trains on the same track with different stopping patterns. Because of time penalties associated with acceleration and deceleration, it is generally

desirable to cluster station stops, rather than operate a “skip stop” type service where trains skip some stations, alternating skipped stations with served stations.

Zone service requires less precise operation than an express-local overtake. Depending on the pattern of station stops and scheduled dispatch times of the trains, zone service may allow closer scheduled headways (without signal delay) than conventional all-stops service.

4.3 Increased Maximum Speed Service

The study team analyzed alternative future RVL signal systems that would support 100 mph instead of retention of the current 80 mph maximum speed in the study’s future scenarios. Although full conceptual design for 100 mph signaling was not performed, the study team’s analysis found that the capacity loss of 100 mph express trains and local trains sharing tracks at any point on the RVL between Raritan and Aldene would be too great to support any increase in train frequency.

NJ TRANSIT signal design criteria call for minimum train spacing of about 6100 feet to support 80 mph operation (in practice, the minimum spacing is greater because of inefficiencies in the layout of the fixed block systems). For 100 mph operation, this increases to about 8250 feet. The study team’s 80 mph conceptual cab/no wayside signal design with aggressive signal hardware requirements (block lengths averaging about 1700 feet or more than three times the number of signal locations presently in service on the RVL) produced a minimum theoretical headway for local trains of about 6 minutes or 10 trains per hour. Derating this figure by the standard “theoretical to practical” conversion factor of 25 percent yields a future practical capacity of 7.5 trains per hour for an 80 mph design speed. This figure does not reflect additional capacity losses related to trains with different stopping patterns/average speeds (express versus local) operating on the same track.

With 100 mph express train operation and some shared track usage between Raritan and Cranford, the 7.5 trains per hour would be reduced by:

- Express trains needing additional scheduled spacing at some locations on the line in order to close in on local trains operating on the same track (because the express trains have higher average speeds than the local trains),
- Minimum train spacing of 8250 feet versus 6100 feet, an increase of about 35 percent (which is directly proportional to increased minimum headways and decreased line capacity).

The study team found that support for 100 mph express trains on the same tracks as local trains at any point on the RVL would reduce line capacity to between 3 and 4 trains per hour, with no possibility of higher capacity operations except for construction of a continuous express (third) track for the entire Raritan-Aldene length. The resultant capacity was deemed too low to support future RVL growth and, therefore, 100 mph design speeds are not reflected in any of the study’s scenarios.

5 Future Infrastructure Concepts

The study team investigated three types of RVL Capacity Expansion infrastructure improvements:

- Higher capacity signaling,
- Express (third) track,
- Turnback tracks located off of the mainline.

5.1 Higher Capacity Signaling

The study team developed a conceptual higher capacity signaling system using five cab signal aspects. This system complies with NORAC Rule 562 ("Movements in Territory Where Cab Signals are Used Without Fixed Automatic Block Signals") and features cab signal aspects for Maximum Speed, 60 mph, 45 mph, 30 mph and Restricted Speed. The maximum design speed for passenger trains is 80 mph, consistent with the current top speed on the RVL. The conceptual cab/no wayside design was applied to all study scenarios. For those scenarios with new interlockings (see below), the design was subject to minor adjustments so that signal locations coincide with interlocking limits.

The design was completed in compliance with NJ TRANSIT signal design safe braking distance standards for passenger trains. The design features 73 new cab-signal-only "master locations", each of which feed two tracks. The design has an average circuit length of about 1700 feet. Although there are variations due to grade and signal spacing, the control line design generally provides for:

- Track circuit being entered clear – Restricted Speed,
- Track circuit being entered clear plus 1 circuit clear – 30 mph cab signal aspect,
- Track circuit being entered clear plus 2 circuits clear – 45 mph cab signal aspect,
- Track circuit being entered clear plus 3 circuits clear – 60 mph cab signal aspect,
- Track circuit being entered clear plus 5 circuits clear – Maximum Speed cab signal aspect.

It should be noted that the minimum block length for the RVL concept design is shorter than the comparable block length on the NEC. This is because the minimum block length on the NEC is based on 15 mph to stop signal design safe braking for freight trains equipped with the Locomotive Speed Limited (LSL) system. The NJ TRANSIT signal design freight braking distances are shorter than those required under Amtrak signal design criteria.

While the concept design for RVL Higher Capacity Signaling is based on an 80 mph design speed, the location of the signal blocks would accommodate modification of the system to support 100 mph passenger train operation in the future. In general, control lines would need to be extended by two additional blocks (about 3400 feet in total), with the two new intermediate locations provided with NJT's 80 mph cab signal aspect.

Appendix C includes the conceptual higher capacity signal design as applied to Scenario 1. The designs for the other scenarios are virtually the same, except for interlocking locations related to the third (express) track (Scenarios 2 and 3) and turnback locations (Scenario 4).

5.2 Third (Express) Track

The study team identified constraints along the ROW that may preclude the addition of a third track, shown in Appendix D. The significant investments made by NJ TRANSIT at Plainfield and Westfield Stations in the form of station improvements and high level platforms are reflected in this analysis. The study team also endeavored to avoid scenarios with third track at highway/rail at-grade crossings (refer to Section 2.1). The assessment of the feasibility of adding a third track looked, individually, at each side of the two-track RVL. For each side, the team rated third track feasibility in terms of:

- Minimal complexity (color-coded in blue),
- Moderate complexity (color-coded in green),
- Average complexity (color-coded in yellow),,
- Significant complexity (color-coded in magenta), and
- Greatest complexity (color-coded in red).

The scope of the study did not include a detailed assessment of the extent to which buried fiber optic lines, signal power, communications and vital signal cables would need to be relocated to support a new third (express) track. It is clear that significant cable relocation would be required; the study's capital cost estimates include generic provisions for such relocations without benefit of a comprehensive corridor utility and sub-surface cable survey that will need to be performed as part of the subsequent design effort.

With the exception of the unusual configuration at Cranford, Appendix C shows existing low level platforms rated as average complexity (yellow) in supporting a new third track. This is because the low level platforms are built on the trackbeds of the former outer ("local") tracks and will need to be reconstructed should an express track be inserted in the middle (forcing the relocation of one of the current local tracks outward to occupy the former local trackbed). At Cranford, the Aldene Plan platforms remain, with a full four trackbeds between the low level platforms. The insertion of a new express track in the middle at Cranford would be relatively straight-forward as a result.

The two high level platforms on the line – at Plainfield and Westfield – are color-coded red (for "greatest complexity"). Constructing a third track through these locations will involve design and construction challenges requiring additional consideration if no less complex alternatives are identified. This is because of the need to demolish and reconstruct one or both of the recently-constructed high level platforms at each of these stations, where the high level platforms are located on the former outer ("local") trackbed.

At Dunellen, at the east end of Bound Brook and at the west end of Raritan, the two-track RVL has been relocated to occupy the two northern trackbeds of the four historical trackbeds. Therefore, expansion to the north would be extremely difficult and expensive. However, expansion to the south would be relatively straight-forward. Alternatively, the two existing tracks could be relocated to the middle trackbeds at these three locations, freeing up a trackbed on the north side. This is particularly true at Dunellen, where three undergrade bridges in the vicinity of the passenger station (Washington Ave, Prospect Ave and Madison Ave) govern the track alignment.

The recently-rehabilitated Ambrose Brook undergrade bridge at Milepost 28.77 does not alter the complexity of adding a new track on the north side, as the two existing RVL tracks use the two northern-most bays. This is the reason for the red color-coding between Milepost 28.7 and 29.9 on the north side. The south side of the RVL at this location poses little complexity in adding a new track, as shown in Appendix C.

At Milepost 31.15, there is a two-track undergrade bridge that spans Middle Brook, just east of Interstate 287. The bridge spans from the former four-track RVL configuration have been removed at this location. Therefore, there would be some expense in adding a track here – either north or south of the existing two tracks. This segment of the RVL is color-coded yellow in the Appendix D graphics.

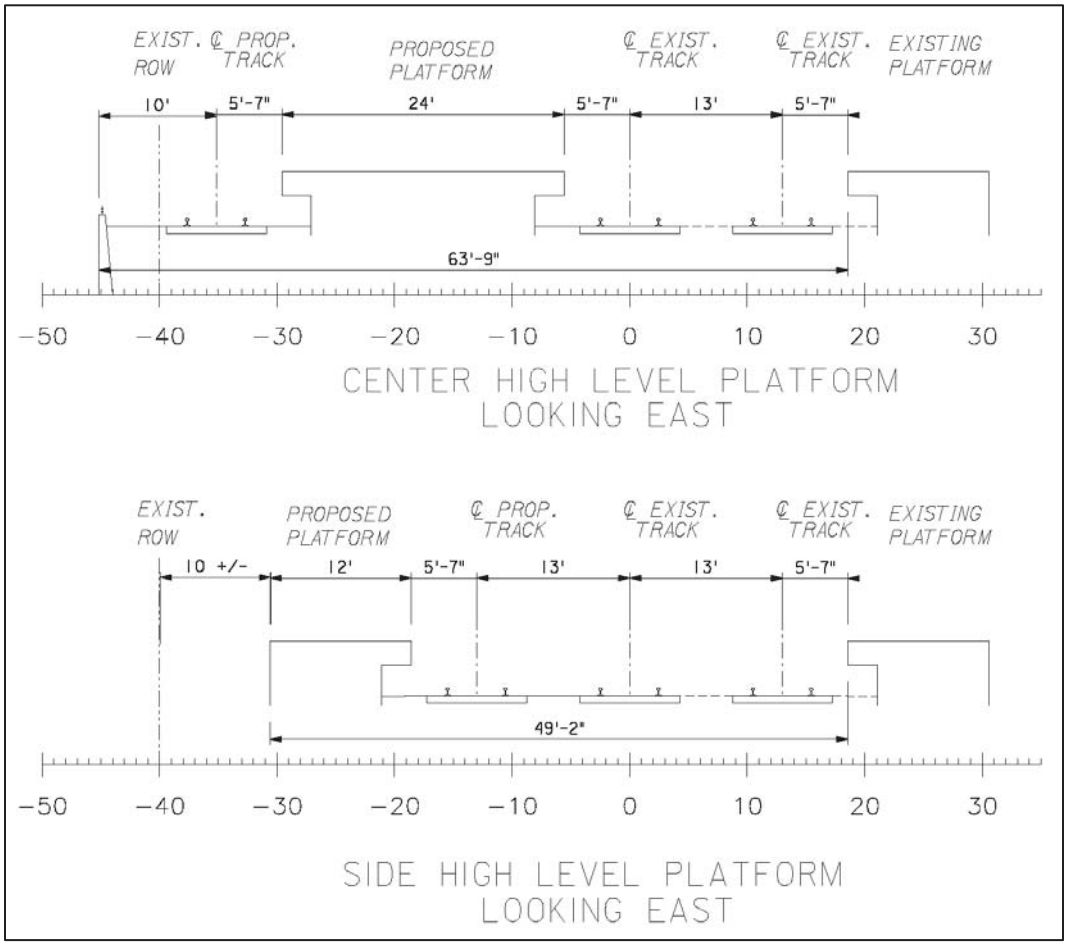


Figure 1 – Two alternative Plainfield Station cross-sections with third express track, showing three track access (top) and outside track only access (bottom).

Through an iterative process with the operations planning work, the study team investigated RVL corridor locations that would have the potential ability to accept a third track. Scenarios were developed that reflect the physical characteristics of the area including civil items, engineering considerations, presence of utilities, and the relationship to adjacent communities and environmentally sensitive areas (refer to Section 7). Careful attention was paid to station areas, such as Plainfield Station shown in Figure 1, because platform requirements also pose the greatest constraint in terms of expanding the number of tracks while staying within the NJ TRANSIT right of way. These assessments are based on

information from NJ TRANSIT, including rail GIS base mapping data and LiDAR survey data.

Sketch plans were developed at a scale of 1" = 40' indicating the locations of the proposed infrastructure improvements. These working level planning diagrams, shown in Appendix E, Appendix F and Appendix G, depict changes to the existing track alignment, station platforms, walkways, bridges, signals, instrument houses, utilities and other infrastructure elements.

Interlockings defining the limits of the third (express) track use #32.75 turnout geometry, with all movements (straight on the local tracks or diverging to the express track) rated for 80 mph for passenger trains.

With Westfield ridership significantly higher than those at other RVL stations (refer to Section 2.4), the study team focused on platform access for all three tracks at this location should an express track pass through the station. While the station had four tracks historically (refer to the 1912 drawing shown in Figure 2), the design solutions identified by the study team involve complex construction and total replacement of the recently-constructed high level platforms at this station. Figure 3 shows a plan view of a three-track concept for Westfield with platform access on all three tracks. The existing south side high level platform is retained with a new 24 foot wide center island platform built to the north. The 24 foot wide center island platform is a more aggressive approach than the 26 foot minimum width called for in the NJ TRANSIT design standards. Using 13 foot track centers (an aggressive approach that provides tighter track centers than the 14 foot minimum NJ TRANSIT criteria for new construction), Figure 4 shows that the resultant station encroaches into the historic station building on the north side by about 5 feet.

The study team also investigated an alternative to the Figure 3 design solution that places the island platform between the two southern tracks, with a side platform on the north side, shifting tracks and platforms to avoid conflicts with the historic structures on north and south. This design solution was found to be geometrically feasible at a concept level (including use of existing bridge spans east and west of the station) but has the following drawbacks:

- The normally eastbound local track would have permanent 50 mph speed restrictions east and west of the station in order to make "S" curve transitions from the bridge spans to the platform trackway (the other two track would retain their 80 mph maximum operating speed),
- The recently-constructed side platforms on both north and south would need to be demolished, with the new north side platform about 13 feet farther north than its current location,
- The recently-constructed elevators and pedestrian subway would need to be demolished and reconstructed.

Given these complexities, the study team did not advance future scenarios with three tracks through Westfield.

Figure 2 –NJ TRANSIT archives drawing showing 1912 plan and profile for Westfield Station with four-track configuration between eastbound and westbound local platforms.

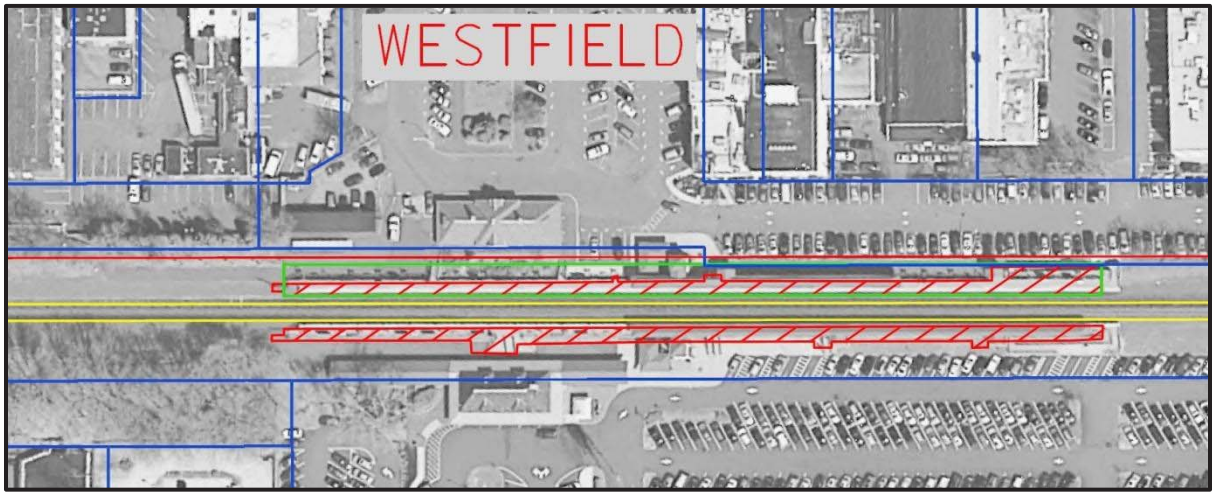


Figure 3 – Plan view of potential Westfield track and platform configuration with new north side third track and platform access for all three tracks.

Figure 4 – Profile of potential Westfield track and platform configuration with new north side third track and platform access for all three tracks. Note that the new third track encroaches on the historic building on the north side (left side of the profile).

5.3 Turnback Tracks

Turnback tracks allow trains to terminate and change direction without occupying main track. While the RVL presently has one mainline turnback train (Train 5902, originating at Plainfield), its use of a main track for such an operation can exacerbate delays when operations are disrupted. In the recent past, NJ TRANSIT has scheduled more than one RVL turnback during peak periods with the change of direction occurring on the mainline.

Turnback tracks, which are short sections of third main track connected to the mainline with an interlocking, allow trains to terminate/originate at locations other than terminals and yards while supporting high reliability. “Short turning” trains at turnback locations (either mainline or off the mainline) can help to control operating costs and reduce rolling stock requirements by targeting service at the highest ridership segments of a line. NJ TRANSIT presently has such a turnback track at South Amboy on the North Jersey Coast Line; the third (Gladstone Branch) track at Summit serves a similar function.

The study team developed concepts for three turnback locations where westbound trains can terminate and eastbound trains can originate off of the main line. The three locations are Westfield, Plainfield and Bound Brook. Selection of the locations was driven by the availability of ROW for the turnback as well as service planning considerations in terms of locations that represent a strong ridership “break point” (strong eastbound boarding volumes and strong westbound alighting volumes immediately to the east of the turnback).

In the cases of Westfield and Plainfield, local site conditions also support turnouts from the turnback track to the mainline at the western end of the turnback track. While these connections would not normally be used by revenue trains, they would allow an originating train trip to be fed from Raritan Yard or a terminating train trip to operate as non-revenue trip to the yard (after allowing through revenue trains to pass by).

All turnback tracks are designed for a minimum 900 foot train length (between points of switch and 50 foot wayside signal setbacks there from). This supports a nine-car plus locomotive push-pull train in the pocket with 25 feet of signal preview distance on each end.

5.3.1 Westfield

This concept design features a turnback track between the two mainline RVL tracks with a walkway adjacent to the turnback track. The walkway enables the train engineer to change ends while walking adjacent to the train and without fouling the adjacent mainline track. The concept design features #20 lateral turnouts from the mainline, along with a #10 equilateral where the two turnout leads converge to form the turnback or "pocket" track. The RVL mainline tracks are realigned with gentle "S" curves to pass outside of the center turnback track, with the mainline curves designed to 80 mph passenger train standards. This configuration is duplicated on both east and west ends of the turnback track, allowing use of the track to turn trains in either direction or to "pocket" a freight or MOW train,

The maximum passenger train operating speed through the turnouts and on the turnback track will be 45 mph, though signal design safe braking distance considerations will produce a 30 mph entering speed when the leaving signal at the other end of the turnback track is at stop. Based on NJ TRANSIT passenger train signal design safe braking distance criteria, the cab signal will drop to Restricting in this situation as soon as the train enters the turnback track itself (exits the entering interlocking). Trains departing the turnback will receive 45 mph cab signal aspects and a Limited Clear wayside aspect under normal operations.

The Westfield Turnback Track concept design calls for the track to be located west of the station, bounded by Crossway Place undergrade bridges on the west and Westfield Avenue on the east. The existing four track undergrade spans at Tuttle Parkway are used to support the turnback track and associated crew walkway.

5.3.2 Plainfield

The Plainfield Turnback Track is identical in configuration to the Westfield Turnback Track. It is bounded on the west by the Plainfield Avenue (Route 28) undergrade bridge and on the east by the Park Avenue (County Road 531) undergrade bridge (which is located immediately west of the Plainfield Station platforms). The Plainfield Turnback Track and associated walkway use the following undergrade bridges, all of which retain their former four-track span configurations:

- Liberty Street,
- New Street,
- Central Avenue, and
- Madison Avenue.

None of the shortlisted scenarios presented in this report include the Plainfield Turnback Track. The conceptual engineering drawings for this improvement are contained in Appendix H rather than in the scenario-specific alignment drawings presented in other appendices.

5.3.3 Bound Brook

The Bound Brook Turnback Track utilizes a portion of the existing connection between the Conrail Shared Assets Lehigh Line and the RVL in Bound Brook. While this track is actively used by freight trains, such movements occur almost exclusively outside of peak periods. Therefore, the study team believes that the RVL-Lehigh Line Connecting Track can be used both for RVL freight access and to support peak period RVL turnback operations, given the distinct time-of-day differences in these two types of train movements.

This proposed turnback location reconstructs the normally eastbound Bound Brook side platform as an island platform between the normally eastbound RVL and a new south side turnback location. The actual train turnback location would be at a platform edge, eliminating the need for a walkway for the train crew to change ends.

The existing left hand and right hand main-to-main RVL crossovers at Brook Interlocking would remain. The left hand turnout to the Lehigh Line connection would be reconfigured as a long #15 crossover. The new south side station track would continue to provide access to the three freight car storage tracks located west of the station and south of the RVL mainline.

Due to the #15 geometry, passenger trains would be limited to 30 mph leaving the Bound Brook Turnback. Trains entering the turnback would be limited to 30 mph through Brook Interlocking, with their cab signal dropping to Restricting once through the interlocking limits. An “End of Circuit” sign would be placed at the west end of the new station track; access to the freight car storage tracks to the west would continue to be via uncircuited hand-throw switches.

6 Future Operations/Infrastructure Scenarios

6.1 Scenario 1 (80 MPH MAS, Five Aspect Cab/No Wayside System)

Scenario 1 features only the High Capacity Signal System capital improvement, without any third (express) track or turnback tracks. Scenario 1 has no programmed overtakes but adds two peak period peak direction trips (two eastbound trips in the morning, two westbound trips in the evening). The eastbound (peak direction) morning peak period operating pattern is shown in Table 7 while the westbound (peak direction) evening peak period pattern is shown in Table 8.

Table 7 – RVL Eastward AM Peak Stopping Pattern
(Departing Raritan 5:30 – 9:00 AM, Future Scenario 1)

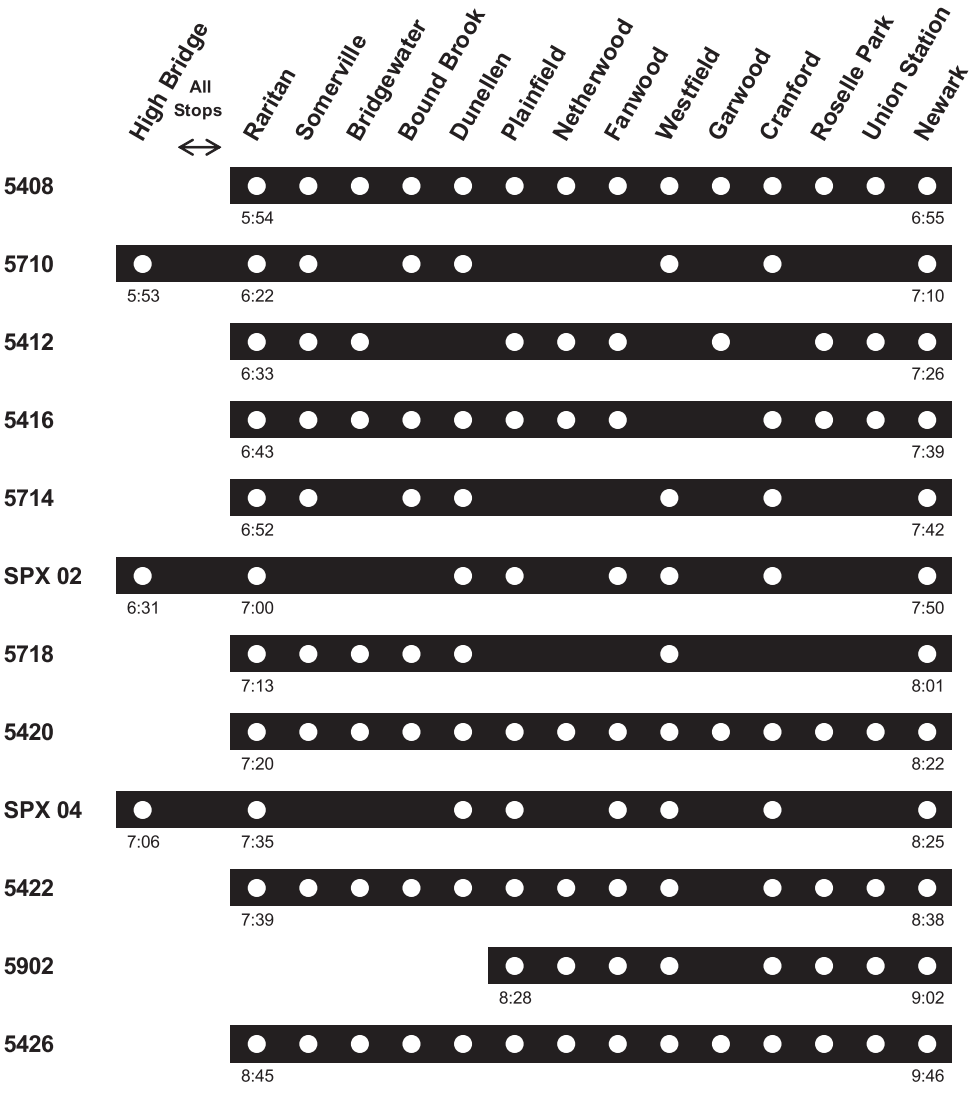
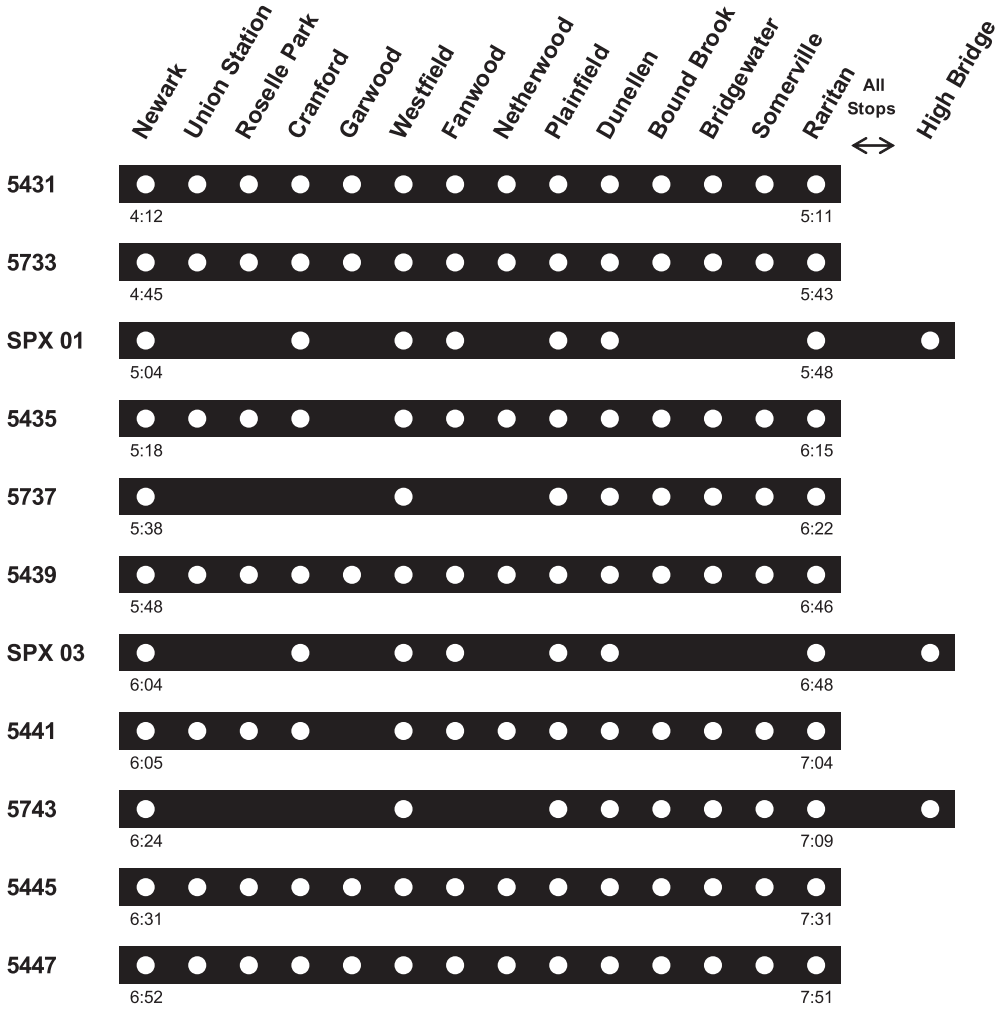


Table 8 – RVL Westward PM Peak Stopping Pattern
(Departing Newark 4:00 – 7:00 PM, Future Scenario 1)



6.2 Scenario 2 (80 MPH MAS, 3rd Track West of Westfield to Queen)

Scenario 2 builds on Scenario 1 with both the High Capacity Signal System and a new center third (express) track that passes through the Netherwood and Fanwood Stations. The new express track is constructed in the trackbed of the present westbound track, with a new westbound local track constructed to the north. New trackage to the north avoids impacts to the historic station structures at Netherwood and Fanwood, both located on the south side of the RVL.

Scenario 2 includes two new peak period peak direction trips making only Westfield and Raritan Station stops within the study territory. The Scenario 2 operating pattern for morning peak period operation is shown in Table 9 while the corresponding evening peak period operation is shown in Table 10. The red segments in the two tables represent use of the third (express) track.

Table 9 – RVL Eastward AM Peak Stopping Pattern
(Departing Raritan 5:30 – 9:00 AM, Future Scenario 2)

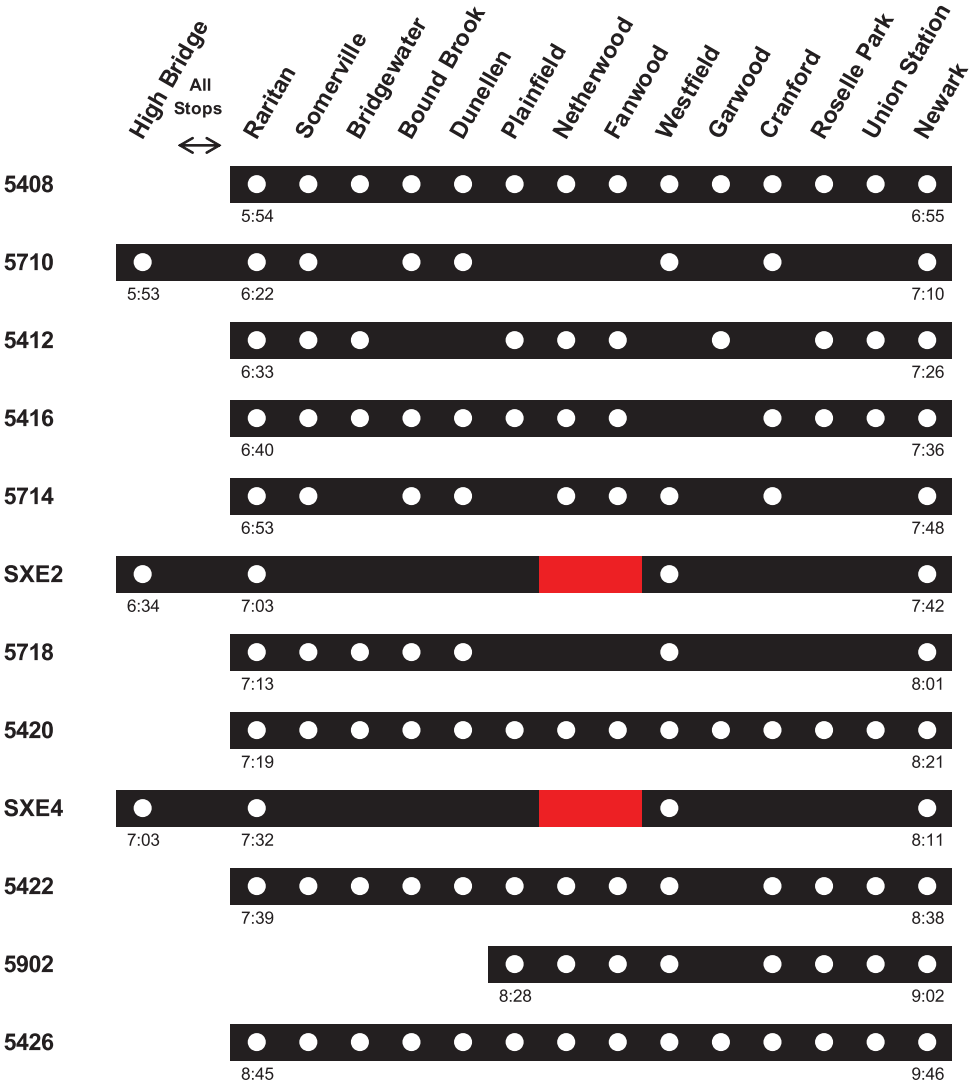
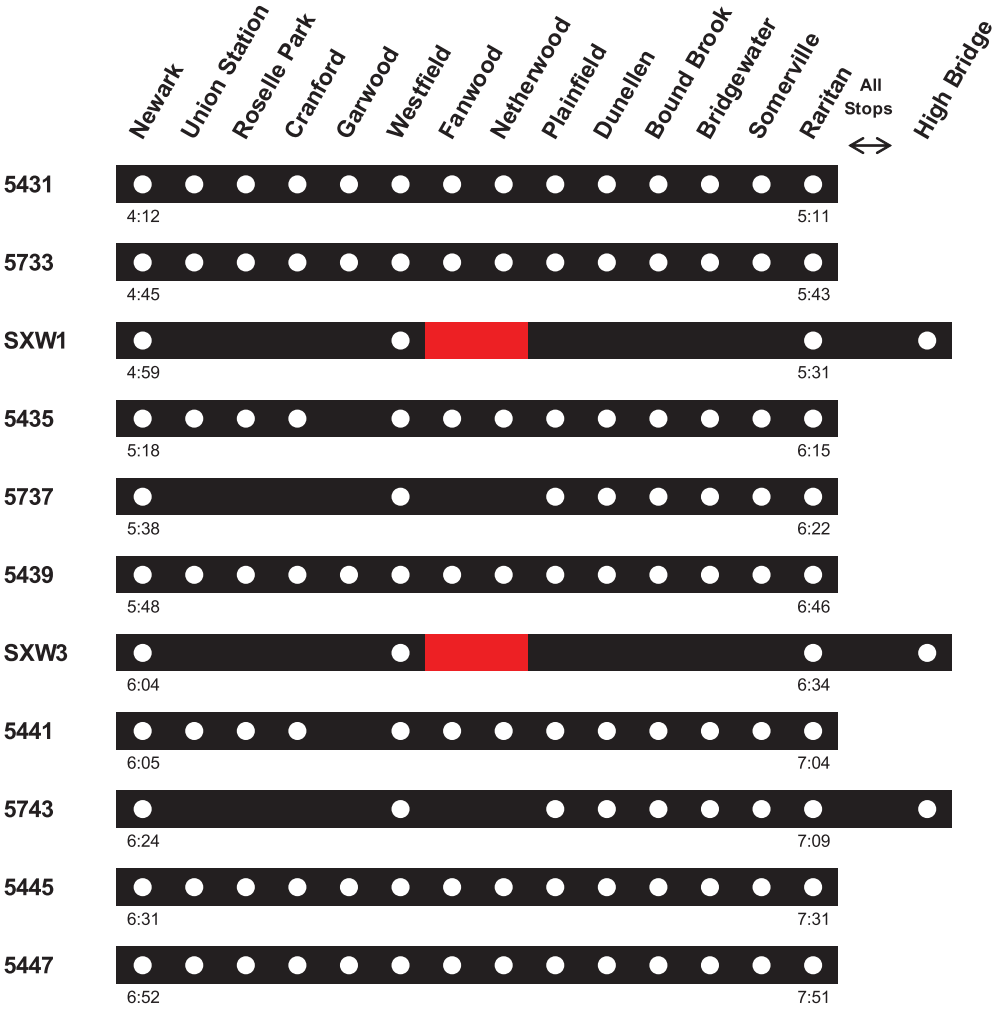


Table 10 – RVL Westward PM Peak Stopping Pattern
(Departing Newark 4:00 – 7:00 PM, Future Scenario 2)



6.3 Scenario 3 (80 MPH MAS, 3rd Track West of Westfield to West of Plainfield)

Scenario 3 builds on Scenario 2 with both the High Capacity Signal System and a longer center third (express) track that passes through the Plainfield, Netherwood and Fanwood Stations. As with Scenario 2, the new express track is constructed in the trackbed of the present westbound track, with a new westbound local track constructed to the north. New trackage to the north avoids impacts to the historic station structures at Plainfield, Netherwood and Fanwood, all located on the south side of the RVL.

As with Scenario 2, Scenario 3 includes two new peak period peak direction trips making only Westfield and Raritan Station stops within the study territory. The Scenario 3 operating pattern for morning peak period operation is shown in Table 11 while the corresponding evening peak period operation is shown in Table 12. The red segments in the two tables represent use of the third (express) track.

Table 11 – RVL Eastward AM Peak Stopping Pattern
(Departing Raritan 5:30 – 9:00 AM, Future Scenario 3)

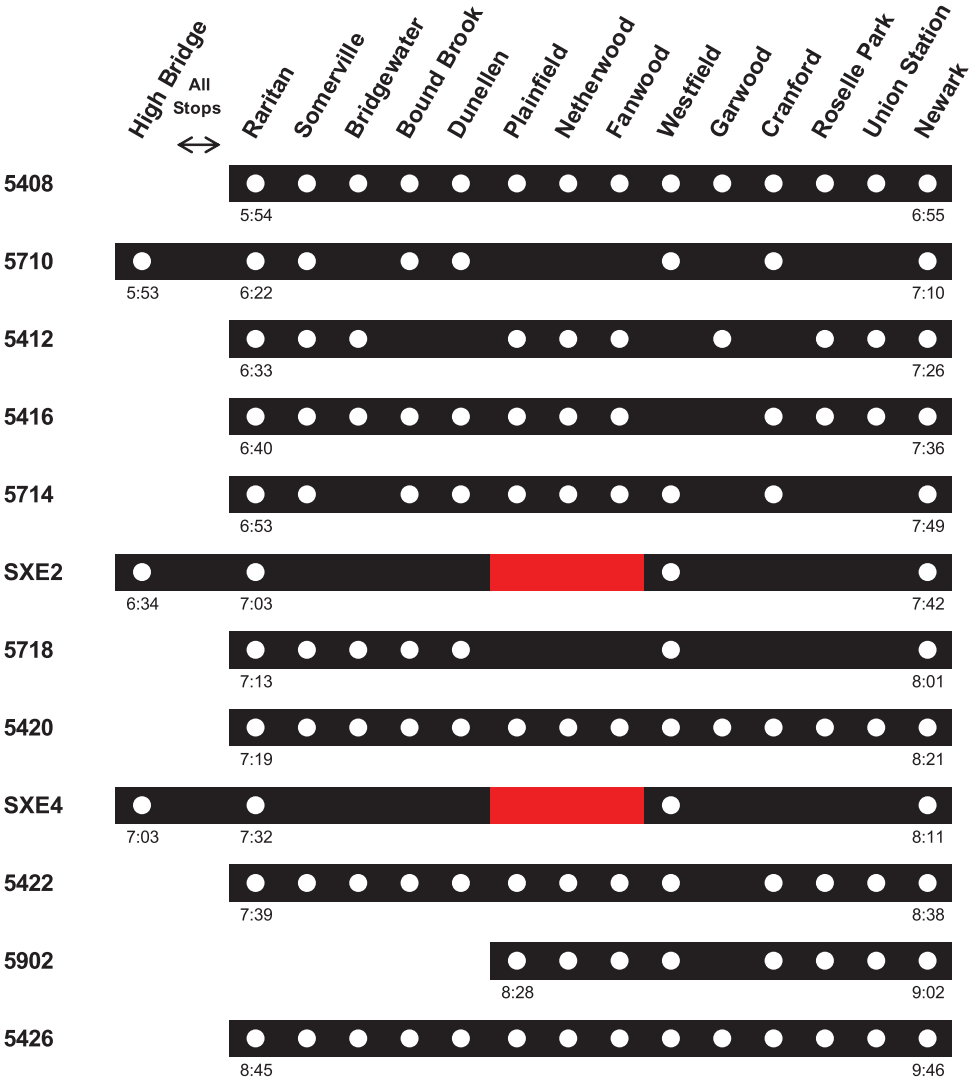
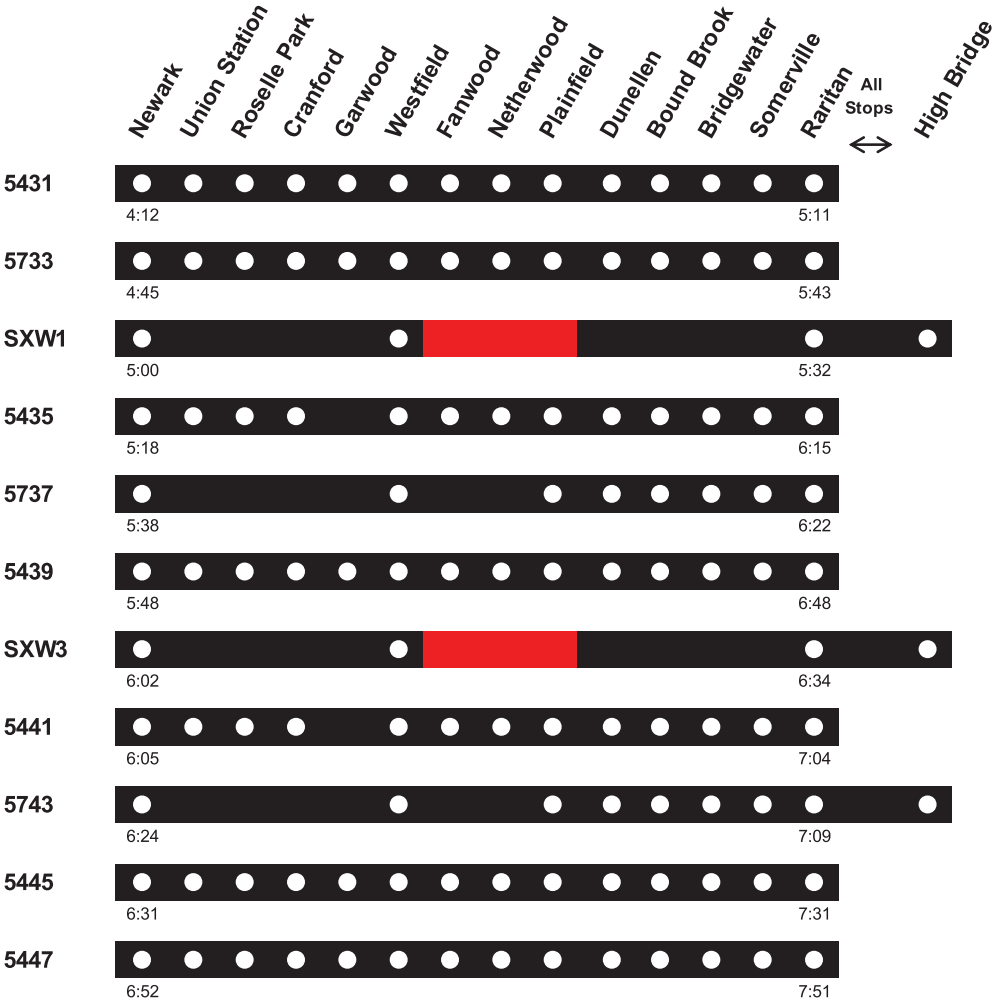


Table 12 – RVL Westward PM Peak Stopping Pattern
(Departing Newark 4:00 – 7:00 PM, Future Scenario 3)



6.4 Scenario 4 (80 MPH MAS, Westfield Pocket, Bound Brook 3rd Track)

Scenario 4 represents an alternative approach to Scenarios 2 and 3, with new zone service rather than new express track and associated express trains. As with all scenarios, it includes a new high capacity cab/no wayside signal system with five aspects. It features a new Westfield Center Turnback track and a new third station track for train turning at Bound Brook. During the "peak of the peak", this layout effectively allows three service zones – Union to Westfield, Westfield to Bound Brook and Bound Brook to Raritan (with many trains extended to High Bridge. The Scenario 4 operating pattern for morning peak period operation is shown in Table 13 while the corresponding evening peak period operation is shown in Table 14. There is no third (express) track in Scenario 4 so no color-coding is used.

Table 13 – RVL Eastward AM Peak Stopping Pattern (Departing Raritan 5:30 – 9:00 AM, Future Scenario 4)

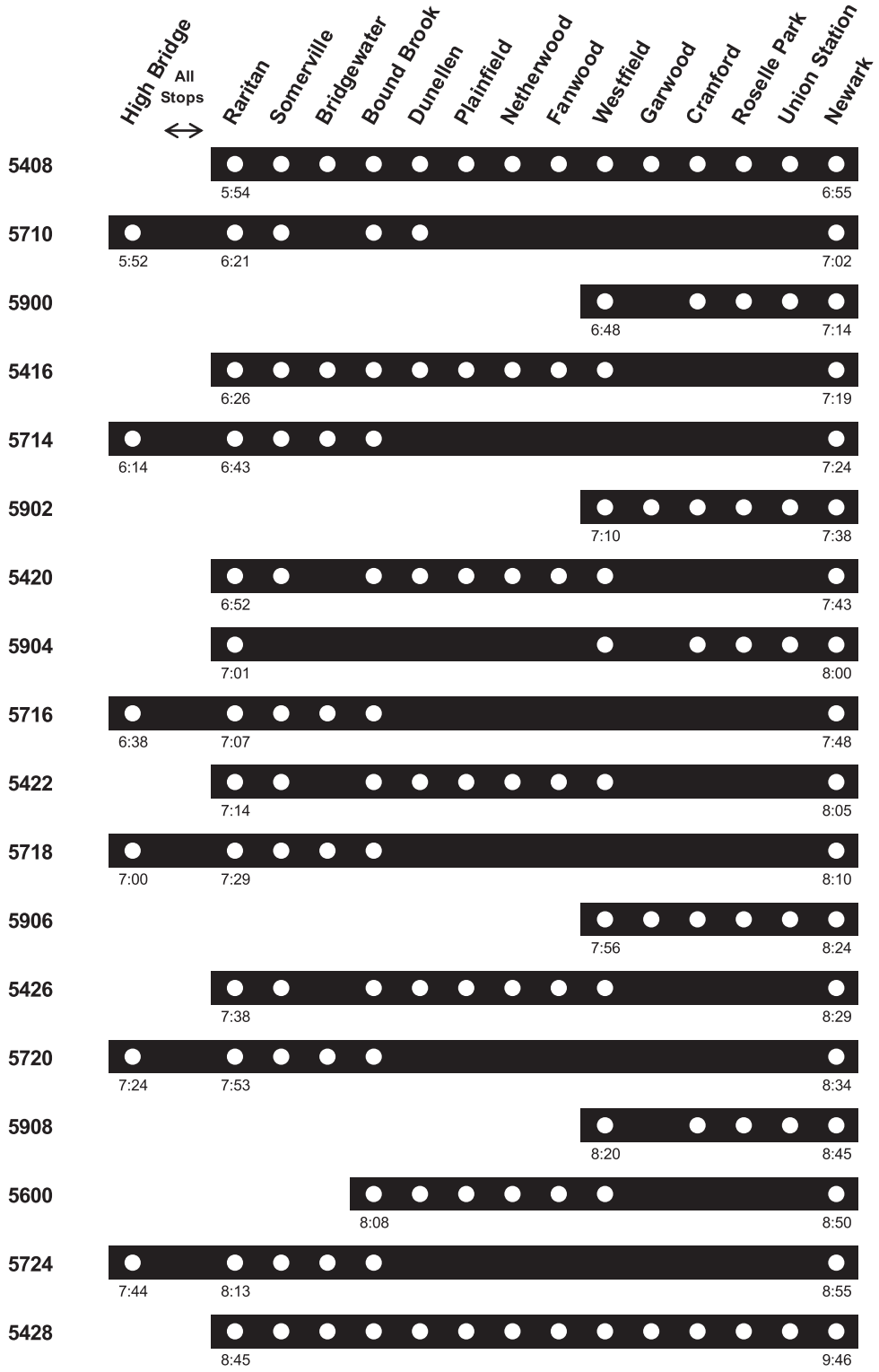
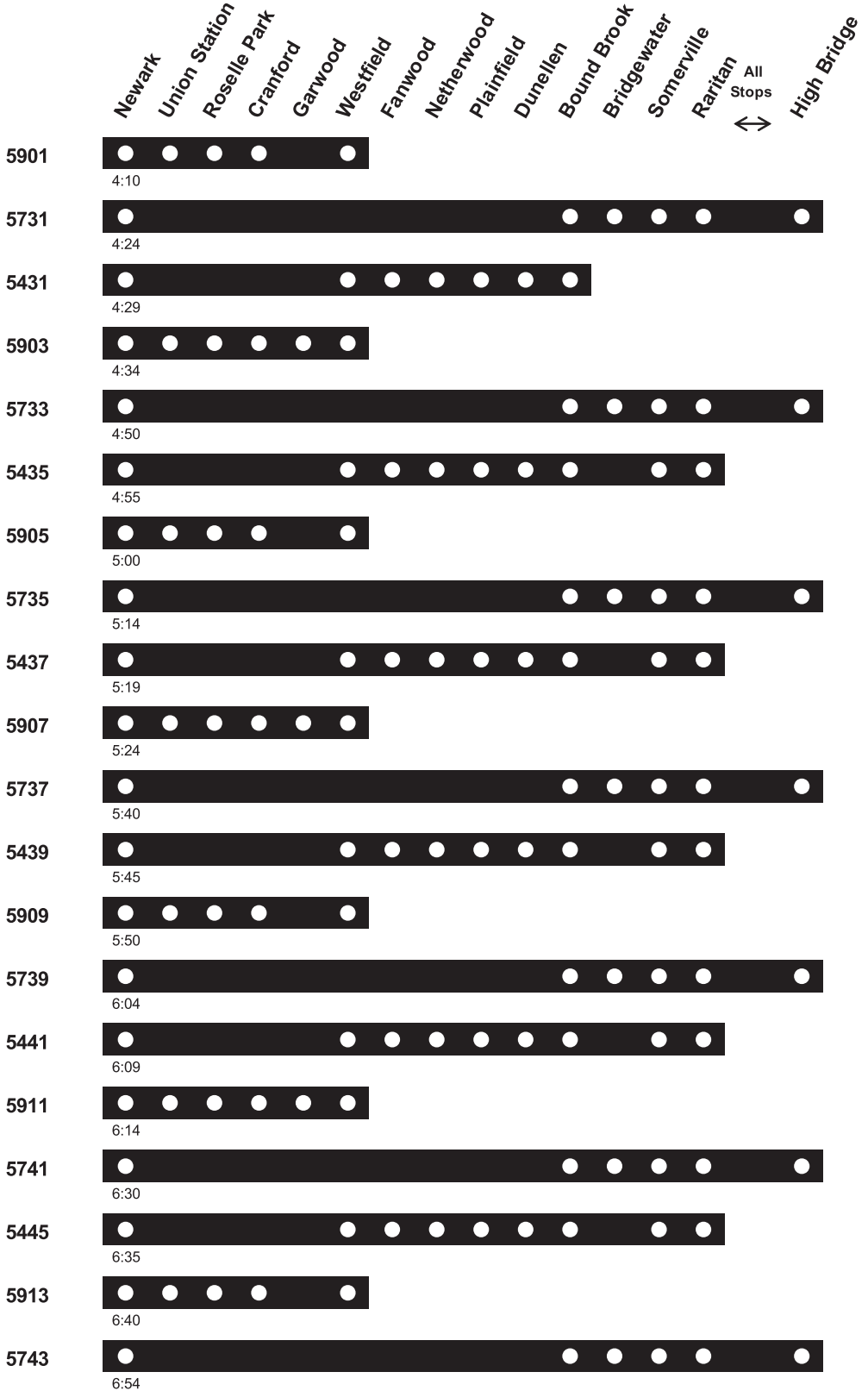


Table 14 – RVL Westward PM Peak Stopping Pattern (Departing Newark 4:00 – 7:00 PM, Future Scenario 4)



7 Environmental Constraints

A “preliminary”, first-cut screening of potential environmental issues for the transportation, social, built, and natural environment was performed along the area of the RVL under study (Aldene to Raritan). Coordination with the NJ TRANSIT Office of Local Government and Community Affairs was conducted to assist in identifying at a high level potential community issues for consideration in the environmental screening. Issues evaluated in the screening included:

- *Land Use / Neighborhood Character* – Identification of where the proposed project bisects areas that function as neighborhoods and adjacency issues between new track and existing uses.
- *Land Acquisitions and Displacements* – The extent of land acquisition required and type and number of displacements required.
- *Consistency with Local Plans* – Consideration of local and regional plans in the study area, including future transit and freight plans.
- *Socio-Economics/Environmental Justice* – The extent of impacts on low-income or minority areas.
- *Transportation* – Identification of impacts that would occur from each alternative on traffic patterns and passenger and freight rail services, with particular attention to any issues associated with at-grade rail crossings.
- *Noise and Vibration* – Using the screening distances identified in the FTA guidance manual, estimation for the proposed project of the number of impacted sensitive resources.
- *Hazardous Materials* – Number, extent, and locations of potential involvement with contaminated parcels or buildings.
- *Parklands and Farmlands* – Potential for proposed project to impact existing or planned parklands, farms or open space, with particular emphasis on identification of any impacts to green acres sites.
- *Ecology* – Presence of any impact to wetlands, streams, and environmentally sensitive areas.
- *Floodplains* – Proximity to or extent of location within the 100-year floodplain.
- *Cultural Resources* – Extent of impact to listed, eligible, or potentially eligible historic buildings or subsurface areas noted as having potential archeological resources; consideration to be given to issues associated with the RVL designation as a historic corridor by the NJ SHPO.

7.1 Current Environmental Conditions

The project area was screened to identify environmental constraints within the project area and to determine if there are any areas of concern. The four scenarios developed as part of this study were examined in order to identify the potential environmental constraints and probable land use permits NJ TRANSIT may anticipate prior to construction. The New Jersey Department of Environmental Protection (NJDEP) will be the primary regulatory agency governing natural resource land use activities.

Existing geographic information systems (GIS) natural resource mapping and aerial photography of the proposed project corridor was reviewed to identify the aforementioned environmental constraints adjacent to and within the project corridor. Sources included the NJDEP 2007 ortho-aerial photography and 2007 NJDEP Land Use freshwater and linear wetland mapping.

Floodplains throughout the project corridor were identified using the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Program, GIS, Q3 Flood Data. FEMA Flood Insurance Rate Maps (FIRM) were additionally used in identifying floodplains throughout the project corridor. The 100-year floodplain limits shown are from the current NJDEP State Adopted Study for the Raritan River. NJDEP has not yet revised its documents to reflect the recent improvements by the US Army Corps of Engineers to the lower Middle Brook, Green Brook and Raritan River floodplains. Until the NJDEP has updated its flood mapping, it is not clear to what extent (if any), the recent improvements remove NJ TRANSIT's property from the 100-year floodplain.

The NJDEP Known Contaminated Sites List GIS information was reviewed in order to identify any potential hazardous sites adjacent to the study corridor. Hazardous materials may be anticipated at any location with a history of use or creation of hazardous materials where project-related excavation could occur. However, known past history is not always an indicator of the presence of hazardous materials. Pollutants may have migrated through groundwater and unreported or unintended deposition of hazardous materials may have occurred along the project corridor.

The above information was compiled and presented on the project aerial base mapping which may be found in Appendix I.

7.2 Discussion of Potential Permits

A Freshwater Wetland (FWW) permit and Transition Area Wavier would be required for encroachment into freshwater wetland areas or their transition areas. The state protects wetlands and transition areas under the New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B). After wetland delineations are performed along the project corridor, an application to the NJDEP should be made for a Letter of Interpretation (LOI) to verify the delineated wetland boundaries. The LOI, once issued, will serve as a legal document verifying the wetland boundaries for a period of five years. It will also classify the wetlands within the project area according to their resource value. The resource value classification assigns a regulated transition area of 50 or 150 ft. as previously mentioned.

Wetland complexes are designated a resource value classification depending on the value and function the wetland demonstrates, i.e. the threatened and endangered species that the area may be habitat for and the trout production status of the surface water the wetland may be associated with. "Exceptional" resource value wetlands are designated a 150 foot transition area buffer and "Intermediate" resource value wetlands receive a 50 foot transition area buffer. Wetlands that are of "Ordinary" resource value have no transition area buffer. Wetland mitigation would need to be performed within the same U.S. Geologic Survey designated HUC 11 watershed or within the same Watershed Management area. The area of land required for mitigating for lost wetlands is generally calculated through a ratio of 2:1 to as high as 4:1, i.e. creating 2 to 4 acres of wetland for every one acre destroyed. Mitigation ratios may depend upon the severity of the impact to the wetland, size of the wetland and the resource value classification.

A Flood Hazard Area (FHA) permit from NJDEP will be required for any work occurring in associated floodplains or riparian areas. If any unmapped regulated streams or linear wetlands are identified within the area of disturbance, and has a drainage area greater than 50 acres, including a definable bed and bank, than a Flood Hazard Area may be required. Riparian area mitigation would be required to mitigate losses caused by any permitted disturbance.

An NJDEP water quality certificate may need to be obtained and endangered / threatened / priority species surveys or mitigation efforts may be required from the U.S. Fish and Wildlife and/or NJDEP Natural Heritage Program.

A New Jersey No Net Loss Reforestation plan may need to be prepared if more than one half acre of deforestation is planned along the project corridor.

7.3 Preliminary Screening of Scenarios

7.3.1 Scenario 1

Scenario 1 has no natural resource impacts or potential regulatory permit requirements as this scenario involves changes to the signal system only.

7.3.2 Scenario 2 (Sheets 27 - 34, 40, and 41)

Scenario 2 begins in the City of Plainfield, Union County, and travels east into Fanwood Borough, the Township of Scotch Plains, the Town of Westfield, the Township of Cranford, and Roselle Park Borough where it makes the connection with the Lehigh Valley right-of-way.

A Flood Hazard Area and Wetland Transition Area permit may be required for project impacts associated with an un-mapped stream/linear wetland that runs parallel to the right-of-way at approximately Milepost 21. Floodplains associated with the Green Brook, Cedar Brook, and Ash Brook (Freshwater, Non-Trout = FW2-NT) exist adjacent to the right-of-way.

Known contaminated sites exist adjacent to the project right-of-way. Further investigation of these identified sites is recommended.

7.3.3 Scenario 3 (Sheets 24 - 34, 40, and 41)

Scenario 3 begins in the City of Plainfield, Union County, and travels east into Fanwood Borough, the Township of Scotch Plains, the Town of Westfield, the Township of Cranford, and Roselle Park Borough where it makes the connection with the Lehigh Valley right-of-way.

A Flood Hazard Area and Wetland Transition Area permit may be required for project impacts associated with an un-mapped stream/linear wetland that runs parallel to the right-of-way at approximately Milepost 21. Floodplains associated with the Cedar Brook and Ash Brook (Freshwater, Non-Trout = FW2-NT) exist adjacent to the right-of-way.

Known contaminated sites exist adjacent to the project right-of-way. Further investigation of these identified sites is recommended.

7.3.4 Scenario 4 (Sheets 12-14 and 32-34)

Scenario 4 impacts two areas, one in Bound Brook Borough (Somerset County) and the other in the Town of Westfield (Union County).

A Flood Hazard Area and Wetland Transition Area permit may be required for project impacts associated with the Raritan River (FW2-NT), and Green Brook (FW2-NT). These waterbodies either cross or are adjacent to the project right-of-way.

Known contaminated sites exist adjacent to the project right-of-way. Further investigation of these identified sites is recommended.

Table 15 identifies the potential permits that may be required for the proposed project.

Table 15 – Potential Environmental Constraints

Scenarios	Flood Hazard Area Permit	Freshwater Wetlands Permit	Hazardous Waste Sites
Scenario 1			
Scenario 2	✓	✓	✓
Scenario 3	✓	✓	✓
Scenario 4	✓	✓	✓

8 Capital Cost Estimates

8.1 Overall Approach and Assumptions

Capital costs were developed for the four scenarios evaluated in the study. They reflect the Standard Cost Categories (SCC) implemented by the Federal Transit Administration (FTA) to establish a consistent format for the reporting, estimating, and managing of capital costs for projects.

The study team estimated costs using actual NJ TRANSIT construction and procurement costs where available, including those for the Portal Bridge Capacity Enhancement Project. Unit costs for station work were based on NJ TRANSIT station projects on both the RVL (Plainfield and Westfield) and more recent projects on other lines, adjusted for inflation.

It should be noted that assumed baseline RVL improvements, including double tracking of the Aldene connection and Lehigh Line improvements are not included in the capital cost estimates.

8.2 Bridges

Three of the four scenarios evaluated as part of this study will require that some of the existing undergrade bridges be put back into service. The following bridge locations fall within the four scenario areas.

Milepost	NJDOT STR. NO.	Feature Crossed	Municipality	Bridge Type (Overhead/ Undergrade)	Scenario
19.03	2063-162	Tuttle Parkway	Westfield	OH	4
19.85	2063-164	Hetfield Avenue	Fanwood	OH	2, 3
20.56	2063-165	Martine Avenue	Fanwood	OH	2, 3
20.69	2063-167	Scheelens Crossing	Fanwood	OH	2, 3
21.2	2063-168	Terrill Road	Plainfield	OH	2, 3
21.74	2063-169	Leland Avenue	Plainfield	UG	2, 3
22.35	2063-171	Berkman Street	Plainfield	UG	2, 3
22.62	2063-172	Richmond Street	Plainfield	UG	3
22.85	2063-174	Roosevelt Avenue	Plainfield	UG	3
22.99	2063-175	Watchung Avenue	Plainfield	UG	3
23.13	2063-177	Park Avenue	Plainfield	UG	3
23.28	2063-178	Madison Avenue	Plainfield	UG	3
23.35	2063-179	Central Avenue	Plainfield	UG	3
23.4	2063-180	New Street	Plainfield	UG	3
23.51	2063-181	Liberty Street	Plainfield	UG	3
23.68	2008-150	Plainfield Avenue	Plainfield	UG	3
30.08	1860-152	Main Street	Bound Brook	UG	4

Overhead Bridges

Based on review of available data, it was determined that none of the existing overhead bridges will require improvements. Each of these overhead bridges had previously accommodated a 4-track railroad with 13 foot track centers. It was therefore concluded that there is sufficient room to accommodate the proposed 3-track alignment.

Undergrade Bridges

Scenarios 2 and 3 will require that 2 and 11 existing undergrade bridges be put back into service, respectively. Each of these bridges was evaluated to determine if improvements would be required to restore track and live rail operations on the spans. A review of available bridge inspection reports, visual observations and discussions with the NJ TRANSIT Structural Department were conducted as part of this analysis. It was determined that all of the bridges to be impacted had recently been rehabilitated or are scheduled to be rehabilitated in the near future with the exception of Berkman Street in Plainfield (MP 22.35).

The Berkman Street bridge is in overall poor condition. The controlling as-inspected ratings for the existing girders are E-53 (normal) and E-89 (maximum), with a fatigue rating of E-26, and the controlling as-inspected ratings of the piers are E-45 (normal) and E-79 (maximum). The normal *as-built* ratings of the girders and piers are only E-53 and E-78, respectively. Due to the age of the structure, overall poor condition of the superstructure and low ratings of the superstructure and substructure it was determined that the bridge superstructure needs to be replaced in its entirety. The existing abutments and pier bents can be repaired and modified to accommodate the proposed superstructure geometry. Cost associated with this work is estimated to be approximately $4.6 million.

8.3 Stations

The cost estimates for station improvements in one or more scenarios includes the following cost elements:

Netherwood

- 2 High Level Side Platforms.
- 2 Elevators (ADA compliant ramps may be feasible at a lower cost but were not assumed)
- 2 Stairways
- Temporary Facilities during construction.
- Utilities
- Demolition of 2 Platforms/access.

Fanwood

- 2 High Level Side Platforms
- 2 Elevators.
- 2 Stairways.
- Pedestrian overpass.
- Temporary Facilities during construction.
- Utilities
- Demolition of existing overpass/elevators.
- Demolition of 2 Platforms/access.

Plainfield

- 1 High Level Platform.
- 2 Elevators.
- 2 Stairways.
- Temporary Facilities during construction.
- Utilities.
- Demolition of existing building.
- Demolition of 1 Platform/access.

Bound Brook

- 1 High Level Side Platform.
- 1 High Level Center Island Platform.
- 2 Elevators.
- 2 Stairways.
- Pedestrian overpass.
- Temporary Facilities during construction.
- Utilities
- Demolition of 2 existing platforms/access.

Table 16 provides a summary of the station-related capital costs. Scenario 1 has no station-related costs. Scenario 2 includes the Netherwood and Fanwood station projects whereas Scenario 3 includes Netherwood, Fanwood and Plainfield stations. Scenario 4 includes only Bound Brook station. A critical assumption in the station cost estimates is that the construction of a new high level platform at a station (as a result of a new third track or turnback track) triggers the requirement that all platforms at that station be high level and ADA accessible.

Table 16 – Conceptual Opinion of Probable Cost – Station Summary

STATION	Hi-Level Platform	Stairway	Elevator	Overpass	Demo Exist. Bldg.	Demo Exist. Overpass/ Elev	Demo Exist. Platform/ Access
	$500/SF	$100,000 EA	$600,000 EA	$800/SF	$20/SF	$20/SF	$20/SF
Netherwood	800' X 12'	2	2	-	-	-	800' X 10'
Fanwood	800' X 12'	2	2	100' X 12'	-	80'X10'	800' X 10'
Plainfield	630'x12'	2	2		50'X20'	-	630'X12'
Bound Brook	400'x24' 400'x12'	2	2	100' X 12'	-	-	800'X10'

Table 17 provides additional detail for each of the four station improvement estimates. Note that the figures in Table 17 do not include design, other professional services, permitting, contingency or financing costs. These “soft” costs increase the capital cost estimates of Table 17 by approximately 49% and are reflected in the overall scenario capital costs.

Table 17 – Conceptual Opinion of Probable Cost – Station Detail

Netherwood	Quantity	Unit Cost	Total
Hi-Level Platform	9,600	$500	$4,800,000
Stairway	2	$100,000	$200,000
Elevator	2	$600,000	$1,200,000
Overpass		$800	$0
Temporary Facilities During Construction	1	$50,000	$50,000
Utilities	1	$50,000	$50,000
Demo Exist. Bldg.		$20	$0
Demo Exist. Overpass/Elev		$20	$0
Demo Exist. Platform/Access	8,000	$20	$160,000
		Grand Total	**$6,460,000**

Fanwood	Quantity	Unit Cost	Total
Hi-Level Platform	9,800	$500	$4,800,000
Stairway	2	$100,000	$200,000
Elevator	2	$600,000	$1,200,000
Overpass	1,200	$800	$960,000
Temporary Facilities During Construction	1	$50,000	$50,000
Utilities	1	$50,000	$50,000
Demo Exist. Bldg.		$20	$0
Demo Exist. Overpass/Elev	800	$20	$16,000
Demo Exist. Platform/Access	8,000	$20	$160,000
		Grand Total	**$7,436,000**

Plainfield	Quantity	Unit Cost	Total
Hi-Level Platform	7,560	$500	$3,780,000
Stairway	2	$100,000	$200,000
Elevator	2	$600,000	$1,200,000
Overpass		$800	$0
Temporary Facilities During Construction	1	$50,000	$50,000
Utilities	1	$50,000	$50,000
Demo Exist. Bldg.	1,000	$20	$20,000
Demo Exist. Overpass/Elev		$20	$0
Demo Exist. Platform/Access	7,560	$20	$151,200
		Grand Total	**$5,451,200**

Bound Brook	Quantity	Unit Cost	Total
Hi-Level Platform	14,400	$500	$7,200,000
Stairway	2	$100,000	$200,000
Elevator	2	$600,000	$1,200,000
Overpass	1,200	$800	$960,000
Temporary Facilities During Construction	1	$50,000	$50,000
Utilities	1	$50,000	$50,000
Demo Exist. Bldg.		$20	$0
Demo Exist. Overpass/Elev		$20	$0
Demo Exist. Platform/Access	8,000	$20	$160,000
		Grand Total	**$9,820,000**

8.4 Communications & Signals

The C&S capital cost estimates shown in Table 45 and Table 46 (Appendix N) were developed by the study team, in consultation with NJ TRANSIT C&S. The conceptual cab/no wayside design to provide improved following move headways represents the bulk of the C&S cost in each scenario. The remainder reflects new and/or reconfigured interlockings to support the third track (Scenarios 2 and 3) and turnback locations (Scenario 4).

NJ TRANSIT provided per-square-foot capital costs for each of the typical Central Instrument House ("Signal Bungalow") types used in new C&S construction:

- Two track automatic signal location (8' x 10') - $391 per square foot,
- Three track automatic signal location (8' x 12') - $354 per square foot,
- Interlocking location (8' x 20') - $375 per square foot.

8.5 Rolling Stock

Capital cost for rolling stock is not included in the scenario cost estimates.

8.6 Summary by Scenario

Table 18 provides a summary of the capital costs by scenario, including a breakdown by "hard" (construction) costs and "soft" costs. "Soft" costs include design, construction management, permitting, contingency and finance charges. "Soft" costs increase overall project costs by about 29 percent. Appendix N provides detailed breakdowns of capital cost by study scenario and shows the contingency allocated to each construction cost element (generally 5 to 10 percent). Given the conceptual nature of the RVL capital improvements presented in this report, an additional unallocated contingency equal to 40 percent of estimated construction costs is included. The "soft" costs and unallocated contingency are computed separately and not compounded.

Scenario 1, with only signal improvements, has the lowest cost. Scenario 4, without any new main track has the next lowest cost. Scenarios 2 and 3 have the highest capital costs, with Scenario 3 slightly higher due to the longer third track length included.

Table 18 – Conceptual Opinion of Probable Cost – Summary

Cost Categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4
10 GUIDEWAY & TRACK ELEMENTS	$0	$31,631,250	$41,526,975	$9,530,325
20 STATIONS, STOPS, TERMINALS, INTERMODAL	$0	$14,133,000	$19,624,500	$10,090,500
40 SITEWORK & SPECIAL CONDITIONS	$0	$502,530	$837,900	$482,790
50 SYSTEMS	$20,370,000	$24,297,840	$26,186,790	$21,899,640
CONSTRUCTION SUBTOTAL	**$20,370,000**	**$70,564,620**	**$88,176,165**	**$42,003,255**
60 ROW, LAND, EXISTING IMPROVEMENTS	$0	$0	$0	$0

Table 18 – Conceptual Opinion of Probable Cost – Summary

Cost Categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4
80 PROFESSIONAL SERVICES				
Preliminary Engineering (4%)	$814,800	$2,822,585	$3,527,047	$1,680,130
Final Design (6%)	$1,222,200	$4,233,877	$5,290,570	$2,520,195
Railroad Project Management for Design and Construction (2%)	$407,400	$1,411,292	$1,763,523	$840,065
Construction Administration & Management (8.5%)	$1,731,450	$5,997,993	$7,494,974	$3,570,277
Professional Liability and other Non-Construction Insurance (5%)	$1,018,500	$3,528,231	$4,408,808	$2,100,163
Legal; Permits; Review Fees by other agencies, cities, etc. (1%)	$203,700	$705,646	$881,762	$420,033
SUBTOTAL SECTION 80	**$5,398,050**	**$18,699,624**	**$23,366,684**	**$11,130,863**
90 UNALLOCATED CONTINGENCY (40% of Constr.)	$8,148,000	$28,225,848	$35,270,466	$16,801,302
100 FINANCE CHARGES (2% of Construction)	$407,400	$1,411,292	$1,763,523	$840,065
TOTAL PROJECT COST	**$34,323,450**	**$118,901,385**	**$148,576,838**	**$70,775,485**

9 Analysis of Future Operations/Infrastructure Scenarios

The LTK team used its TrainOps simulation software to analyze the operational benefits of each potential future RVL scenario. These benefits include:

- Improved capacity (minimum supportable headways),
- Improved travel times, either through express trains overtaking local trains or better zone express type operation,
- Improved operational reliability, measured in terms of On-Time Performance (OTP).

The work began with a simulation-based analysis of minimum supportable RVL headways based on existing infrastructure. With 45 second dwells and 7 percent schedule margin (pad), the typical most constraining signal clearing time is about 8 minutes for best aspect. These times, relatively long by industry standards, reflect the preponderance of four-aspect, three-block control lines and relatively long signal-to-signal distances within the study limits.

The results of the existing signal system headway analysis, contrasted with the five aspect cab signal system of Scenario 1, are shown in Table 19. The Scenario 1 results show minimum headways of about six minutes, or about a 25% reduction in clearing time when compared with the existing system. This reduction in most constraining signal clearing time correlates with increased train capacity on the RVL. Table 19 reports the headways using two different types of criteria:

- "No Delay" – train receives a signal system aspect that is not necessarily the best aspect at that location but that does not require a speed reduction. Near station stops, for example, an intermediate 45 or 60 mph cab signal aspect may be sufficient for delay-free operation because the train is slowing for the station stop.
- "All Clear" – train receives the best available signal aspect at each location, even if an intermediate aspect would allow it to operate without travel time penalty. The "All Clear" clearing time is always equal to or greater than the "No Delay" time.

Table 19 – Minimum Supportable Signal System Headways (All Stops Local Trains)

Scenario	Dir.	Criteria	Minimum Headway
Existing	E	No Delay	0:07:46
		All Clear	0:07:49
	W	No Delay	0:07:11
		All Clear	0:07:18
Scenario 1 (Five Aspect System)	E	No Delay	0:05:48
		All Clear	0:06:01
	W	No Delay	0:05:24
		All Clear	0:05:56

The analysis included a generic express/local capacity (minimum supportable headway) simulation that quantifies line capacity should NJ TRANSIT operate a mixture of local and express trains during peak periods. The objective was to insert an RVL "super express" train (making Raritan and Westfield stops only) between local trains. In Scenarios 2 and 3, the express train can overtake the local train in the express (third) track territory. In Scenarios 1 and 4, the express train must follow the local train on the same track. The generic TrainOps simulation results of the four train trips are shown in Figure 5 for Scenario 2. The express train is the third train dispatched from Raritan and overtakes the second local train in the Fanwood-Netherwood Express Track segment. It then follows the first local train from Raritan from Westfield to the Lehigh Line connection at Aldene. Finally, a fourth local train follows the express train from Raritan.

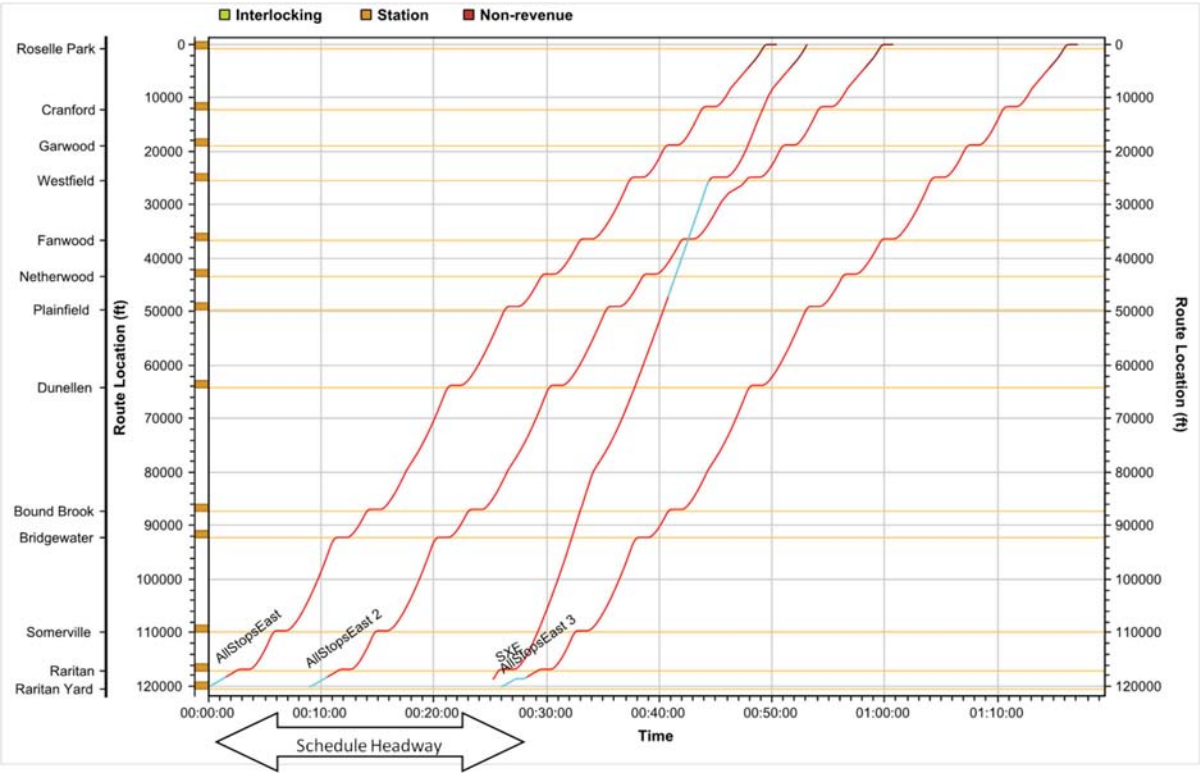


Figure 5 – Local – Local – Express -Local Schedule Pattern

Through iterative scheduling, a simulation was produced for each scenario that has no signal delay (following trains receiving less than best-available aspect) at any location (except for inevitable overtake delay in Scenarios 2 and 3). The endpoint headway between first and fourth trains (which is the same at Raritan and at Aldene, near Roselle Park Station) is reported.

Table 20 shows the minimum four-train headway with repeating Local-Local-Express-Local operating pattern. The headway is reported for both a "super express" train (making Raritan and Westfield station stops only) and for an "express" train (identical to the stopping pattern of current NJ TRANSIT Train 5718, making all stops Raritan to Dunellen, then express to Westfield, then express to the connection at Aldene. As would be expected, the minimum supportable headways of the "express" pattern are better than the "super express" pattern because the "express" pattern (with six stops) has a closer average speed to the local than does the "super express" pattern (with just two stops).

Table 20 – Local-Local-Express-Local Pattern Minimum Headway

Scenario	Schedule	Super Express (Raritan & Westfield Only)		Express (5718 pattern)	
	Direction	WB	EB	WB	EB
Scenario 1 High Capacity Signal System Only	Headway (4 Trains)	0:32:00	0:31:00	0:23:00	0:21:00
	Overtake Delay	N.A.	N.A.	N.A.	N.A.
Scenario 2 High Capacity Signal System & Netherwood to Fanwood Third Track	Headway (4 Trains)	0:26:00	0:27:00	0:18:00	0:19:00
	Overtake Delay	0:01:56	0:01:22	0:02:08	0:02:22
Scenario 3 High Capacity Signal System & Plainfield to Fanwood Third Track	Headway (4 Trains)	00:26:00	00:26:00	00:16:00	00:18:00
	Overtake Delay	00:00:09	00:00:29	00:00:26	00:01:28
Scenario 4 High Capacity Signal System & Bound Brook & Westfield Turnbacks	Headway (4 Trains)	0:32:00	0:31:00	0:23:00	0:21:00
	Overtake Delay	N.A.	N.A.	N.A.	N.A.

5718 Schedule Pattern is all stops from Raritan to Dunellen, and then express to Westfield and Newark. Headway analysis assumes 45-second dwells for Express trains, and 60-second dwells for Super Express trains.

The Table 20 results show that Scenario 3 has the overall highest capacity (shortest headway for the quartet of local-local-express-local trains) of the four scenarios given the local/express operating philosophy. Scenario 2 is close behind Scenario 3. Scenarios 1 and 4, without any express track, have identical minimum supportable headways for the quartet of trains. It should be noted that the ranking of scenarios in Table 20 is specific to local/express train operation. Alternative operating patterns, such as all-local, skip stop and zone express services, would produce different minimum headways per quartet of trains.

For Scenarios 2 and 3, overtaking signal delay results when the eastbound local train reaches the end of the three-track RVL segment before the overtaking express train has cleared sufficiently ahead. As would be expected, the shorter Scenario 2 overtake produces more signal delay than the longer Scenario 3. It should be noted that the simulated trains are precisely scheduled and have no operating variability associated with them. In actual operation, overtaking delay is likely to be somewhat greater than reported by the simulation due to operating variability.

Table 21 reports 24-hour weekday simulated on-time performance between Raritan and Roselle Park for each scenario. The table also shows the number of scheduled trips on the line, which ranges from 52 in Scenario 1 to 73 in Scenario 4. Scenarios 2, 3 and 4 all produce OTP of about 97 percent, based on the standard 5:59 reportable lateness threshold. Scenario 1 has somewhat poorer OTP of about 91 percent using the same standard.

Table 21 – Full Day Simulated On-Time Performance

Scenario	Lateness Threshold	*00:01:00*		*00:05:59*		*00:10:00*		All Trips	
	Train Class	Trains	Pct (%)	Trains	Pct (%)	Trains	Pct (%)	Trains	Pct (%)
Scenario 1 (High Capacity Signal System Only)	***All Trips***	12	21.1	52	91.2	57	100.0	57	100.0
	Express	0	0.0	2	100.0	4	100.0	4	100.0
Scenario 2 (High Capacity Signal System & Netherwood to Fanwood Third Track)	***All Trips***	13	22.8	55	96.5	57	100.0	57	100.0
	Express	2	50.0	4	100.0	4	100.0	4	100.0
Scenario 3 (High Capacity Signal System & Plainfield to Fanwood Third Track)	***All Trips***	13	22.8	55	96.5	57	100.0	57	100.0
	Express	2	50.0	4	100.0	4	100.0	4	100.0
Scenario 4 High Capacity Signal System & Bound Brook & Westfield Turnbacks	***All Trips***	32	42.7	73	97.3	75	100.0	75	100.0
	Express	5	20.0	25	100.0	25	100.0	25	100.0

Table 22 – Peak Period Peak Direction Simulated Travel Time (Raritan-Roselle Park, Including Express Trains)

Scenario	Period	Min	Max	Average
Scenario 1 (High Capacity Signal System Only)	AM Peak	0:34:54	0:45:43	0:38:55
	PM Peak	0:35:00	0:44:30	0:40:11
Scenario 2 (High Capacity Signal System & Netherwood to Fanwood Third Track)	AM Peak	0:25:58	0:46:49	0:37:10
	PM Peak	0:24:55	0:47:32	0:38:03
Scenario 3 (High Capacity Signal System & Plainfield to Fanwood Third Track)	AM Peak	0:25:52	0:45:41	0:37:04
	PM Peak	0:24:55	0:44:58	0:37:35
Scenario 4 High Capacity Signal System & Bound Brook & Westfield Turnbacks	AM Peak	0:31:21	0:43:33	0:35:40
	PM Peak	0:28:46	0:40:06	0:33:06

Table 22 reports simulated travel times for peak period peak direction trains operating between the study's endpoints – Raritan and Roselle Park. Because none of the scenarios experience significant signal delay, the statistics presented in the table are largely driven by the operating plan specific to each scenario. Scenario 4, with a richer level of service and

relatively more express operation than the other scenarios, exhibits the best results (about 36 minutes eastbound in the morning, about 33 minutes westbound in the evening). Scenarios 2 and 3 have similar results of about 37 minutes eastbound in the morning and 38 minutes westbound in the evening. Scenario 1 exhibits the longest travel times, with about 39 minutes eastbound in the morning and 40 minutes westbound in the evening.

Table 23 displays similar data to Table 21 except that it is focused on the local stations bypassed by express trains in Scenario 2 and 3. By reporting travel times between Fanwood and Roselle Park, the table shows the "worst case" results of the overtake scenarios (Scenarios 2 and 3) versus the non-overtake scenarios (Scenarios 1 and 4). Scenario 2 shows slightly longer travel times in the morning peak than do Scenarios 1 and 3. Otherwise, the Scenario 2 and 3 results are comparable to Scenario 1. Scenario 4 shows the best results of all four scenarios due to its richer level of service than others and ability to offer more express and skip-stop type service on the line.

The TrainOps time-distance ("string") chart results for the four shortlisted scenarios are presented in Appendix J (Scenario 1), Appendix K (Scenario 2), Appendix L (Scenario 3) and Appendix M (Scenario 4). The time-distance charts uses different colors for the simulated traces of individual train trips, as follows:

- Blue for Track 1 (normally westbound)
- Red for Track 2 (normally eastbound)
- Light Blue for Other Mainline Tracks (express track in Scenarios 2 and 3, Westfield and Bound Brook Turnback Tracks in Scenario 4).

Table 23 – Full Day Peak Direction Simulated Travel Time (Fanwood-Roselle Park – Stopping Trains Only)

Scenario	Period	Min	Max	Average
Scenario 1 (High Capacity Signal System Only)	AM Peak	0:11:22	0:15:27	0:13:03
	PM Peak	0:13:26	0:15:24	0:14:33
	Full Day	0:11:22	0:15:58	0:14:30
Scenario 2 (High Capacity Signal System & Netherwood to Fanwood Third Track)	AM Peak	0:11:22	0:16:33	0:13:20
	PM Peak	0:13:26	0:15:24	0:14:33
	Full Day	0:11:22	0:16:33	0:14:31
Scenario 3 (High Capacity Signal System & Plainfield to Fanwood Third Track)	AM Peak	0:11:22	0:15:26	0:13:03
	PM Peak	0:13:26	0:15:24	0:14:33
	Full Day	0:11:22	0:15:58	0:14:30
Scenario 4 High Capacity Signal System & Bound Brook & Westfield Turnbacks	AM Peak	0:12:04	0:12:04	0:12:04
	PM Peak	0:10:50	0:11:30	0:11:00
	Full Day	0:10:50	0:15:59	0:14:12

10 Conclusions and Next Steps

NJ TRANSIT future ridership forecasts show that RVL train length increases can accommodate much of the line's forecast growth over the next seven years. While NJ TRANSIT is already operating the maximum supportable peak hour train volume of 6 trains per hour, existing peak period RVL trains can be expanded to 8 Multilevel coaches. When computed over an entire peak hour, this represents a passenger capacity expansion of 31 percent versus the current RVL train consists that include 6 and 7 car trains (the RVL, like most commuter rail lines in North America, has pronounced "peak of the peak" ridership with likely overcrowding during this short time period under future ridership forecasts and no additional trains scheduled). Capacity growth beyond this level will require additional peak period trips which will require some of the capacity expansion projects identified in this study.

The RVL Capacity Expansion Study identified a number of feasible strategies for cost-effective increases in passenger-carrying capacity on the line. The cab/no wayside resignaling of Scenario 1 provides an important capacity benefit, boosting all-stops capacity on each track from about 6 trains per hour to 8 trains per hour. This improvement can be implemented with no apparent environmental issues and a minimum of disruption to the communities abutting the RVL.

Both the third (express) track and turnback track strategies were found to have operational benefits in terms of boosting RVL service. Scenario 3, with its longer segment of third track, is superior to Scenario 2. Both scenarios include the signal system improvements of Scenario 1. Scenario 3 provides for almost delay-free overtakes (though without much margin for day-to-day schedule variations) while the shorter third track of Scenario 2 does not. Because Scenario 2 produces a minute or more of signal delay (under ideal operating conditions with no schedule variability) for each train being overtaken, it is not a viable option. Scenario 3, supporting a three-station overtake, represents the minimum acceptable length of third (express) track for operational viability. Though the study team was unsuccessful in crafting a scenario featuring a four or five station overtake, it is clear that such a significant express track length is needed for delay-free overtakes under typical operating conditions.

Given the distribution of existing RVL ridership along the line, future ridership projections by NJ TRANSIT and operational considerations, it is clear that any third (express) track should be built east of Bound Brook. An express track west of Bound Brook does not provide for a sufficient number of stations stops west thereof to fully load an RVL train (even from High Bridge) and warrant express operation.

Scenario 4 supports service expansion without overtakes but, instead, using a three-zone service (with turnback tracks off of the mainline at the one-third and two-thirds points on the line). Scenarios 3 and 4 represent different approaches, both with appealing operational characteristics, to capacity expansion on the RVL. Scenario 3 supports higher train capacity and passenger throughput than Scenario 4, while Scenario 4 supports greater improvements in RVL passenger travel times than Scenario 3. Scenario 4, with less overall construction, has less community impact than Scenario 3 and an estimated capital cost that is about half of Scenario 3.

All of study scenarios assumed diesel-only locomotive performance, as opposed to "dual power" (electric and diesel) locomotive performance in diesel mode. NJ TRANSIT's ALP-

45DP locomotives are capable of operating in both diesel and electrified territories, including the Northeast Corridor to Penn Station New York. The performance of NJ TRANSIT's diesel-only and "dual power" (in diesel mode) locomotives are very similar. Therefore, the results specific to each of the four study scenarios applies equally to both traditional diesel and "dual power" trains.

Although time and budget considerations did not allow their full feasibility analysis, the study generated additional suggestions for RVL Capacity Enhancements. The following scenarios should be investigated in a more detailed future study:

- Additional detailed alternatives for Westfield Station three-track platform access, including possible construction of one new high level platforms offset longitudinally to avoid historic structures to the east of the new platform,
- Third track from Fanwood to Dunellen, allowing express trains to bypass four station stops made by local trains, and
- Third track from Westfield to Plainfield or Dunellen, without third track access at Westfield, necessitating some revisions to service at the highest ridership RVL station of Westfield but, again, allowing express trains to bypass four station stops made by local trains.

At the same time, an overall RVL Infrastructure Master Plan is needed that joins the work of this study with detailed analysis of capacity improvements east of Aldene. Identified capital projects east of Aldene include:

- Double track Aldene connection between the RVL and the Conrail Shared Assets Lehigh Line,
- Lehigh Line capacity improvements including additional main trackage between CP-Newark (formerly "NK") and Aldene (a third track; NJ TRANSIT and its freight partners have discussed the possibility of a partial or full fourth track as well),
- Hunter Flyover, providing grade-separated access from the RVL Hunter Connection to NEC Track 1,
- Westbound Newark-Waterfront Connection to eliminate at-grade conflicts at the east end of Newark Penn Station (Dock Interlocking) associated with the use of Hudson Yard and the Hudson Pocket Track for turning RVL trains.

While the ultimate RVL train throughput depends on the above east-of-Aldene projects, an RVL Infrastructure Master Plan is needed to determine which intermediate improvements west of Aldene work best with which capacity improvements east of Aldene. Clearly, some RVL service expansion can be achieved without implementing without constructing additional Lehigh Line tracks, the Hunter Flyover or the Westbound Waterfront Connection.

Similarly, while the RVL scenarios investigated in this study assumed traditional diesel-only locomotive performance, the results are equally applicable to NJ TRANSIT's "dual power" locomotive performance (in diesel mode). The RVL Infrastructure Master Plan should include ridership-based analyses to support development of the most cost-effective (and operationally feasible) future growth scenarios where RVL service is operated to multiple eastern terminals.

In terms of next steps, NJ TRANSIT should confirm that it wishes to preserve options for both Scenario 3 and 4 improvements in the long term. It should coordinate among the affected departments to ensure that:

- Applicable unused bridge spans (Scenario 3) continue to be inspected and maintained to the same standard as the adjacent “live” spans,
- Right of way encroachments are prevented or, where occurring, are expeditiously addressed so as to preserve all of NJ TRANSIT’s rights to the full right of way width,
- Applicable right of way is not encumbered by sale or long-term lease,
- Station improvements at Netherwood, Fanwood, Plainfield and Bound Brook are implemented consistent with the long-range improvements contained in Scenarios 3 and 4.

Appendix A. RVL TrainOps® Simulation Rolling Stock Inputs

Table 24 – Locomotive Specifications for Simulation

	PL42AC
Length (feet)	69.83
Weight (pounds)	290000
Number of Axles	4
Maximum Adhesion (percent)	24.0
Continuous Power (HP)	4200
Propulsion System Efficiency (percent)	80.0
Derate Tractive Power for Auxiliary Load	Yes
Auxiliary kW Load (kW)	0.00
Maximum Speed (mph)	100
Initial Acceleration Limit (mph/s)	2.00
Service Brake Rate (mph/s)	2.00
Braking Reaction time (Cab) (seconds)	3.00
Rotational Mass (percent)	5.00
Frontal Area (square feet)	153.50

Table 25 – Tractive Effort PL42AC

Velocity (mph)	Tractive Effort (pounds (F))
0	75000
7	68000
10	64000
16	59000
20	56000
25	46000
30	39000
35	33943
40	29700
45	26400
50	23760
55	21600
60	19800
65	18277
70	16971
75	15840
79	15038
80	1

Table 26 – NJ TRANSIT 2006-2009 Bombardier Multi-level Commuter Car Trailer Specification for Simulation

Weight (pounds)	132900
Length (feet)	85
Number of Axles	4
Passenger Capacity (Seated)	132
Passenger Capacity (Total)	170
Maximum Speed (mph)	125
Average Auxiliary kW Load (kW)	90.00
Power Factor (percent)	85
Rotational Mass (percent)	8.8
Service Brake Rate (mph/s)	2.50
Frontal Area (square feet)	140.00

Table 27 – NJ TRANSIT 2006-2009 Bombardier Multi-level Cab Car Specification for Simulation

Weight (pounds)	139250
Length (feet)	85
Number of Axles	4
Passenger Capacity (Seated)	128
Passenger Capacity (Total)	175
Maximum Speed (mph)	125
Average Auxiliary kW Load (kW)	90.00
Power Factor (percent)	85
Rotational Mass (percent)	8.7
Service Brake Rate (mph/s)	2.50
Frontal Area (square feet)	140.00

Appendix B. Existing Signal System Minimum Headways

Table 28 – Westbound All-Stops Train Cranford to Raritan

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
WB All Stops	T0021	PASS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WB All Stops	T0021	TAIL	[redacted]	[redacted]	[redacted]			
WB All Stops	T0021	PASS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WB All Stops	T0021	TAIL	[redacted]	[redacted]	[redacted]			
WB All Stops	T0021	PASS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WB All Stops	T0021	TAIL	[redacted]	[redacted]	[redacted]1			
WB All Stops	T0021	PASS	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WB All Stops	T0021	TAIL	[redacted]	[redacted]	[redacted]

Table 29 – Westbound Train 5415 – Cranford to Raritan (No stops at Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						
5415	T0008	PASS						
5415	T0008	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Westbound
Schedule Margin - 7%
Schedule Pattern - Cranford to Raritan (no stop Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 30 – Westbound Train 5737 – Westfield to Raritan (No stops at Fanwood and Netherwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						
5737	T0009	PASS						
5737	T0009	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Westbound
Schedule Margin - 7%
Schedule Pattern - Westfield to Raritan (no stops at Fanwood and Netherwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 31 – Eastbound All-Stops Train - Raritan to Cranford

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						
EB All Stops	T0010	PASS						
EB All Stops	T0010	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford (All Stops)
The field highlighted indicates the most constraining minimum supportable headway.

Table 32 – Eastbound Train 5404 - Raritan to Cranford (No Stop at Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						
5404	T0011	PASS						
5404	T0011	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford (no stop at Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 33 – Eastbound Train 5412 - Raritan to Garwood (No Stops at Bound Brook, Dunellen and Westfield)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						
5412	T0012	PASS						
5412	T0012	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Garwood (no stops at Bound Brook, Dunellen and Westfield)
The field highlighted indicates the most constraining minimum supportable headway.

Table 34 – Eastbound Train 5416 Raritan to Cranford (No Stops at Westfield and Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						
5416	T0014	PASS						
5416	T0014	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford (no stops at Westfield and Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 35 – Eastbound Train 5710 - Raritan to Cranford
(No Stops at Bridgewater, Plainfield, Netherwood, Fanwood, Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5710	T0013	PASS	[redacted]					
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						
5710	T0013	PASS						
5710	T0013	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford (no stops at: Bridgewater, Plainfield, Netherwood, Fanwood, Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 36 – Eastbound Train 5714 - Raritan to Cranford
(No Stops at Bridgewater, Plainfield, Netherwood, Fanwood, Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						
5714	T0016	PASS						
5714	T0016	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford (no stops at: Bridgewater, Plainfield, Netherwood, Fanwood, Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 37 – Eastbound Train 5718 - Raritan to Westfield (No Stops at Plainfield, Netherwood, Fanwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						
5718	T0015	PASS						
5718	T0015	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Westfield (no stops at Plainfield, Netherwood, Fanwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 38 – Eastbound Train 5902 - Plainfield to Cranford (No Stop at Garwood)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						
5902	T0017	PASS						
5902	T0017	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Plainfield to Cranford (no stop at Garwood)
The field highlighted indicates the most constraining minimum supportable headway.

Table 39 – Eastbound Non-Stop Train - Raritan to Cranford Express (No Intermediate Stops)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
EB Express	T0024	PASS	[redacted]					
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						
EB Express	T0024	PASS						
EB Express	T0024	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Eastbound
Schedule Margin - 7%
Schedule Pattern - Raritan to Cranford Express (no intermediate stops)
The field highlighted indicates the most constraining minimum supportable headway.

Table 40 – Westbound Non-Stop Train – Cranford to Raritan Express (No Intermediate Stops)

Trip	Train	Event	Time h:mm:ss	Dist (ft)	Cause	Time Needed to Clear Signal Block h:mm:ss	Minimum Supportable Headway for Best Aspect at Signal h:mm:ss	# of Blocks Needed To Receive Clear Signal
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						
WB Express	T0023	PASS						
WB Express	T0023	TAIL						

Train Consist: One PL42AC Locomotive and 7 Bombardier Multi-level Commuter Coaches
Dwell Time Per Station: 45 seconds
Train Direction – Westbound
Schedule Margin - 7%
Schedule Pattern - Cranford to Raritan Express (no intermediate stops)
The field highlighted indicates the most constraining minimum supportable headway.

Appendix C. Conceptual Design of Five-Aspect Cab/No Wayside Signal Control Lines

Raritan Valley WB Control Lines

Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

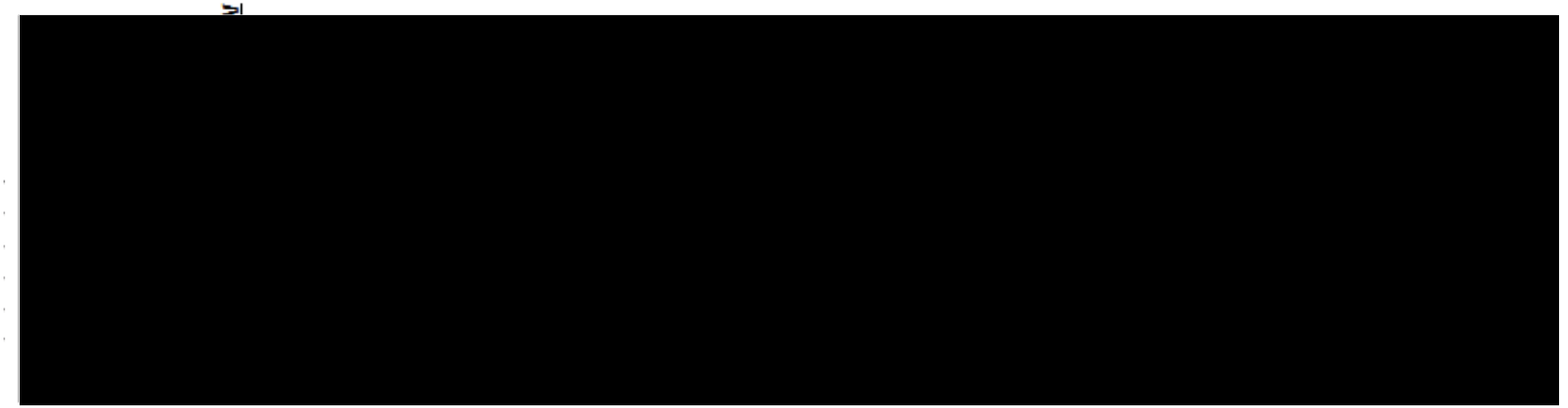
Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

Raritan Valley EB Control Lines



Raritan Valley WB Control Lines

Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

Raritan Valley EB Control Lines

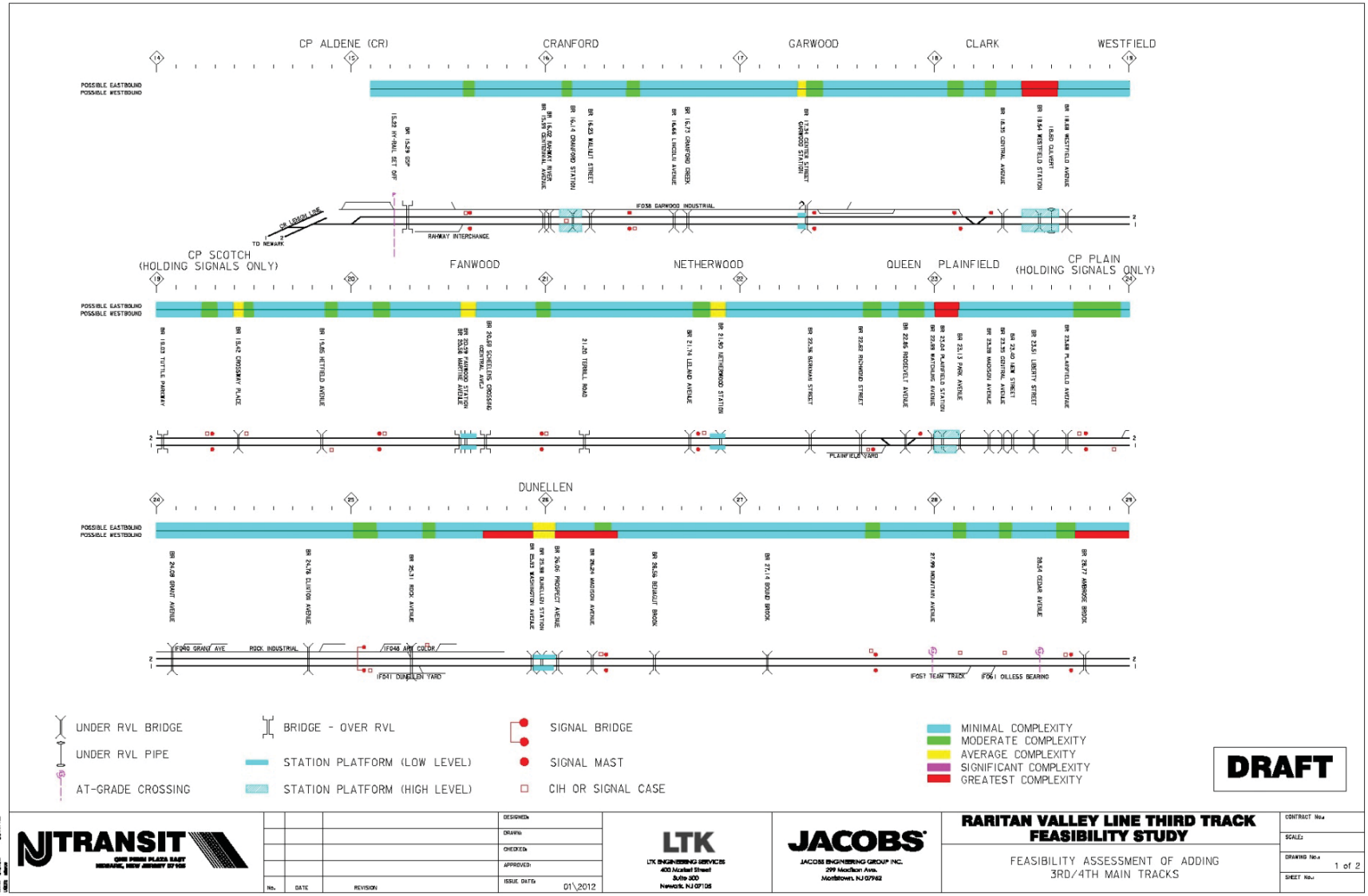
Raritan Valley WB Control Lines

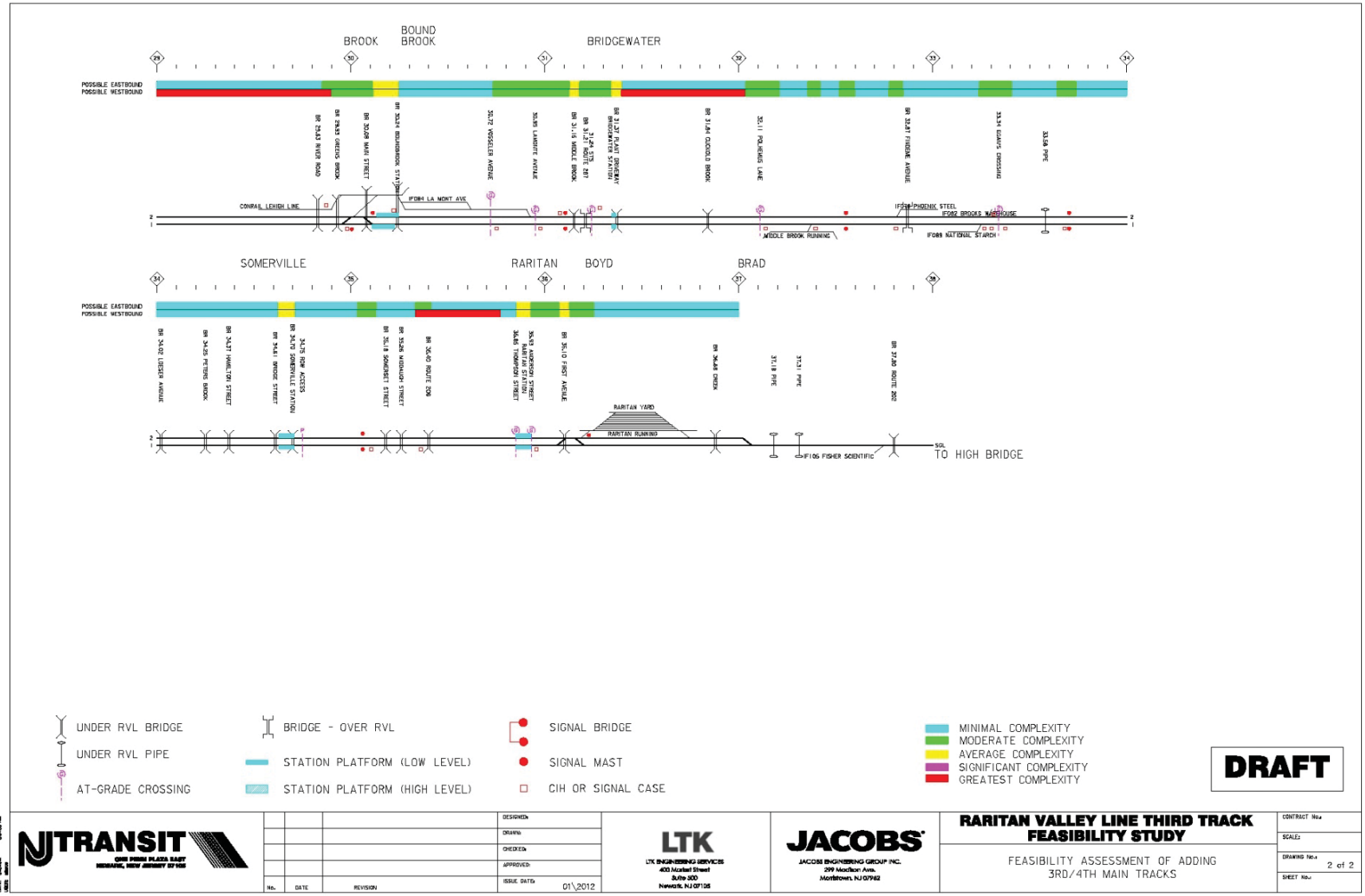
Raritan Valley EB Control Lines

Raritan Valley WB Control Lines

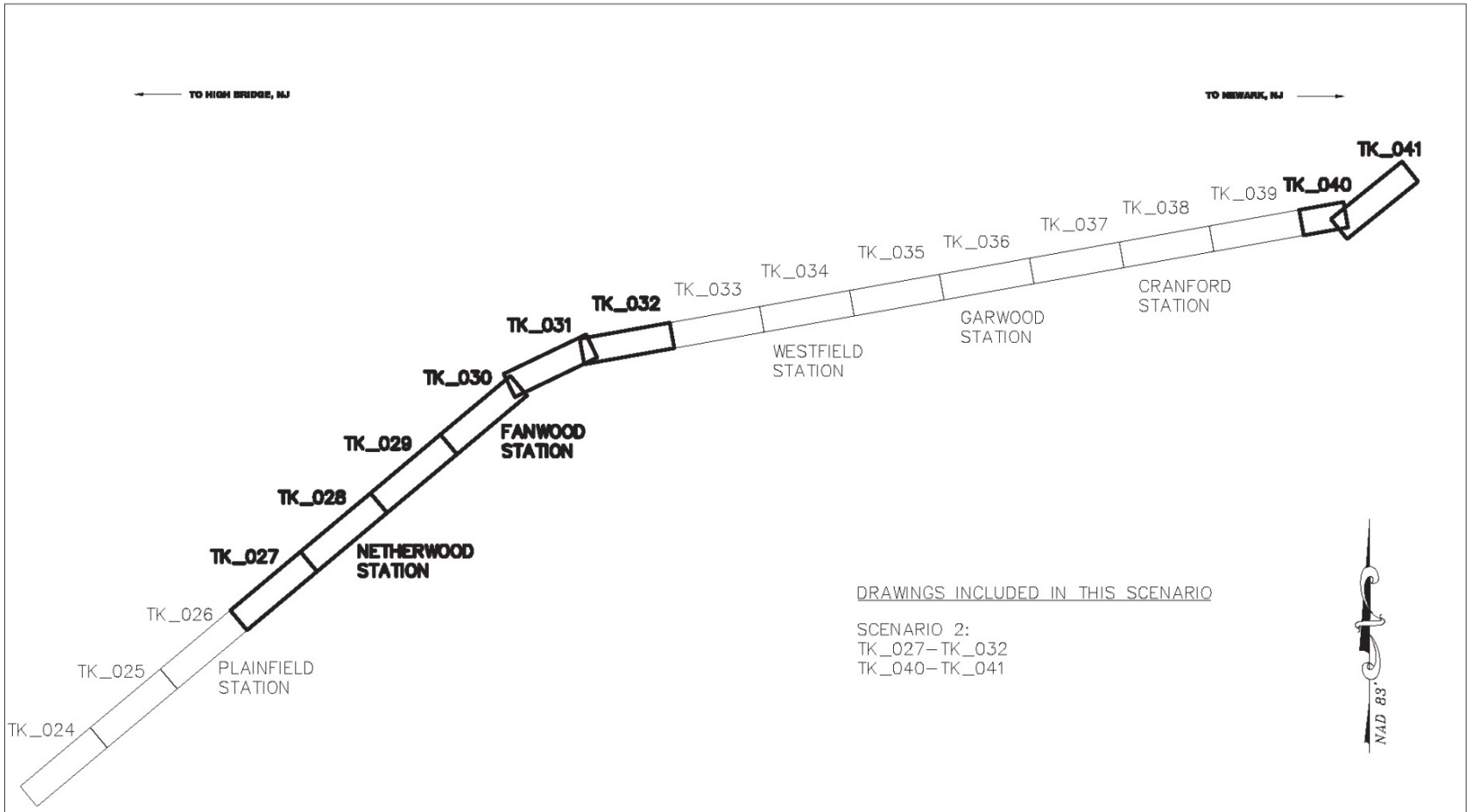
Raritan Valley EB Control Lines

Appendix D. RVL Additional Track Right of Way Constraints


CP ALDENE (CR)
CRANFORD
GARWOOD
CLARK
WESTFIELD
POSSIBLE EASTBOUND
POSSIBLE WESTBOUND
CP SCOTCH
(HOLDING SIGNALS ONLY)
FANWOOD
NETHERWOOD
QUEEN
PLAINFIELD
CP PLAIN
(HOLDING SIGNALS ONLY)
DUNELLEN
UNDER RVL BRIDGE
UNDER RVL PIPE
AT-GRADE CROSSING
BRIDGE - OVER RVL
STATION PLATFORM (LOW LEVEL)
STATION PLATFORM (HIGH LEVEL)
SIGNAL BRIDGE
SIGNAL MAST
CIH OR SIGNAL CASE
MINIMAL COMPLEXITY
MODERATE COMPLEXITY
AVERAGE COMPLEXITY
SIGNIFICANT COMPLEXITY
GREATEST COMPLEXITY
DRAFT
NJTRANSIT
LTK
JACOBS
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
FEASIBILITY ASSESSMENT OF ADDING 3RD/4TH MAIN TRACKS
01\2012
1 of 2


BROOK
BOUND BROOK
BRIDGEWATER
POSSIBLE EASTBOUND
POSSIBLE WESTBOUND
BR 29.63 RIVER ROAD
BR 29.83 GREENS BROOK
BR 30.09 MAIN STREET
BR 30.24 ROBINSON STREET
30.72 VOSSELER AVENUE
30.95 LAMONTE AVENUE
BR 31.16 MIDDLE BROOK
BR 31.27 ROUTE 287
BR 31.37 PLANT DRIVEWAY BRIDGEWATER STATION
BR 31.84 CLOCOLD BROOK
32.11 POLHEMUS LANE
BR 33.07 FINDERNE AVENUE
33.34 ADAMS CROSSING
33.58 PIPE
CONRAIL LEHIGH LINE
IF084 LA MONT AVE
IF086 PHOENIX STEEL
IF082 BROOKS WAREHOUSE
MIDDLE BROOK RUNNING
IF085 NATIONAL STARCH
SOMERVILLE
RARITAN
BOYD
BRAD
BR 34.02 LESSER AVENUE
BR 34.25 PETERS BROOK
BR 34.37 HAMILTON STREET
BR 34.61 BRIDGE STREET
34.75 ROW ACCESS SOMERVILLE STATION
BR 35.18 SOMERSET STREET
BR 35.26 MIDDAUGH STREET
BR 35.40 ROUTE 206
35.59 ANDERSON STREET RARITAN STATION
36.86 THOMPSON STREET
BR 36.10 FIRST AVENUE
BR 36.48 CREEK
37.18 PIPE
37.31 PIPE
BR 37.80 ROUTE 202
RARITAN YARD
RARITAN RUNNING
IF105 FISHER SCIENTIFIC
SGL
TO HIGH BRIDGE
UNDER RVL BRIDGE
UNDER RVL PIPE
AT-GRADE CROSSING
BRIDGE - OVER RVL
STATION PLATFORM (LOW LEVEL)
STATION PLATFORM (HIGH LEVEL)
SIGNAL BRIDGE
SIGNAL MAST
CIH OR SIGNAL CASE
MINIMAL COMPLEXITY
MODERATE COMPLEXITY
AVERAGE COMPLEXITY
SIGNIFICANT COMPLEXITY
GREATEST COMPLEXITY
DRAFT
NJTRANSIT
DESIGNED
DRAWN
CHECKED
APPROVED
ISSUE DATE 01\2012
No.
DATE
REVISION
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
FEASIBILITY ASSESSMENT OF ADDING 3RD/4TH MAIN TRACKS
CONTRACT No.
SCALE:
DRAWING No. 2 of 2
SHEET No.

Appendix E. Scenario 2 Alignment Drawings and Schematic



NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

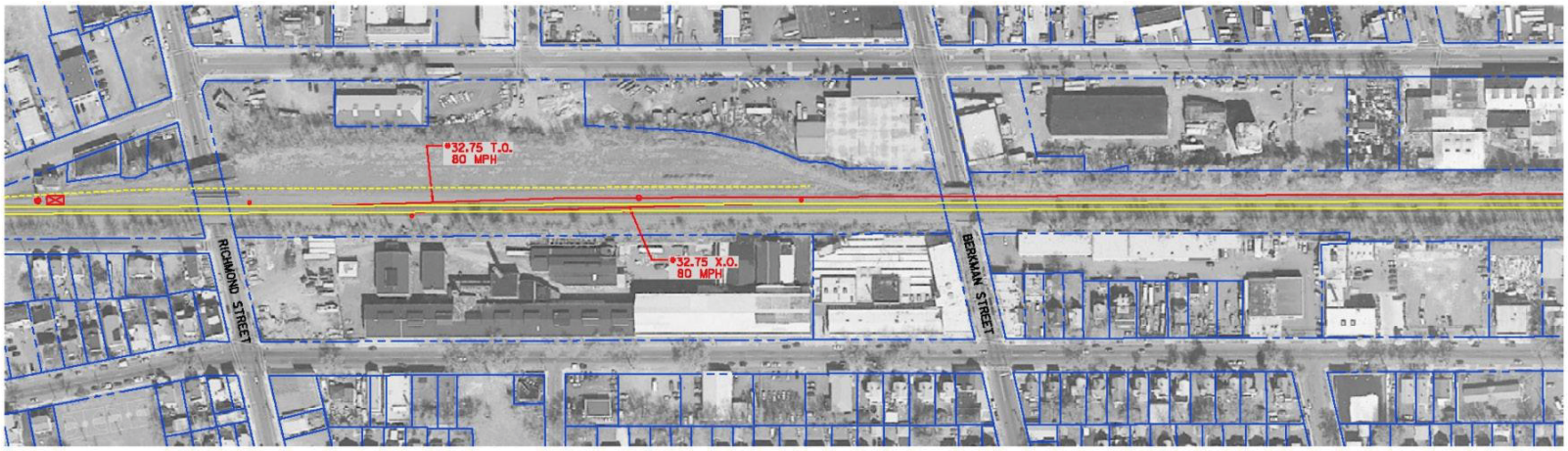
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 500
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

KEY PLAN- SCENARIO 2

CONTRACT No.:
SCALE:
DRAWING No.:
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

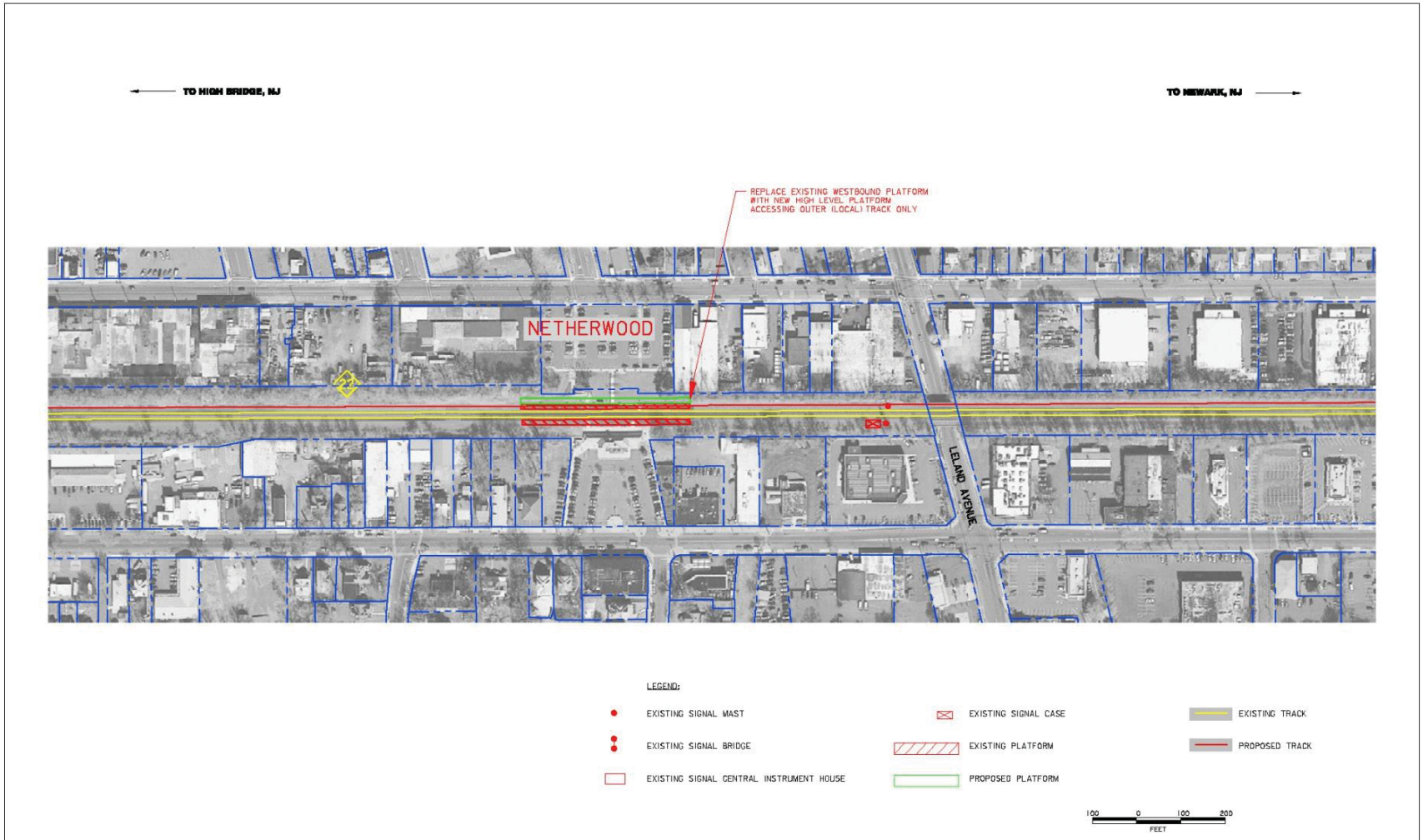
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

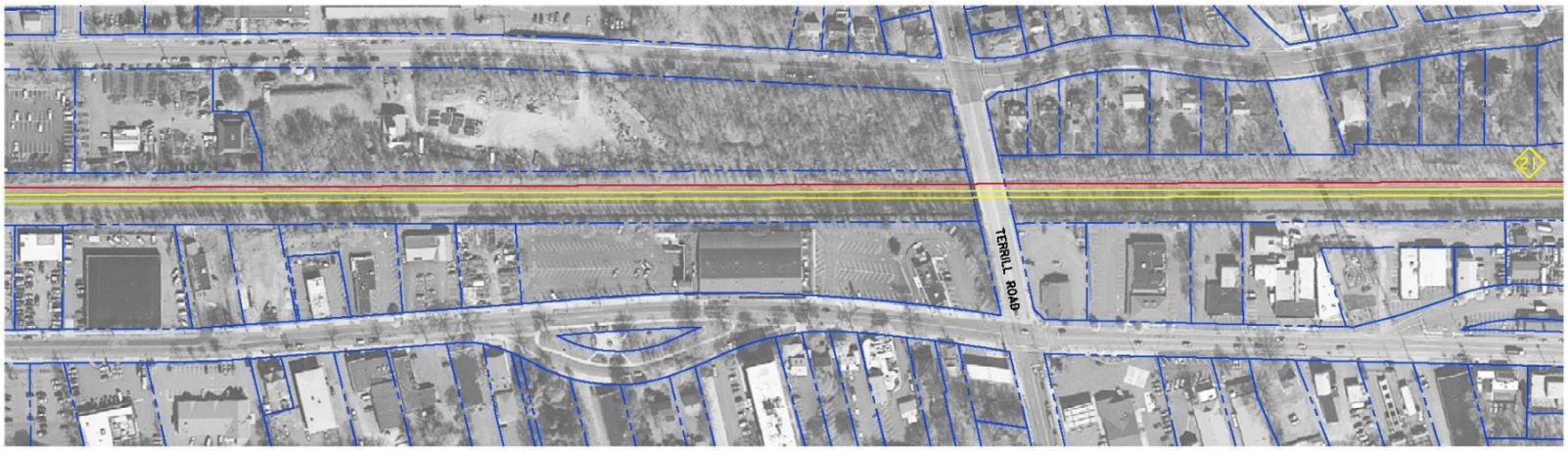
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 22.7 - 22.2

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_027
SHEET No.:


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
REPLACE EXISTING WESTBOUND PLATFORM WITH NEW HIGH LEVEL PLATFORM ACCESSING OUTER (LOCAL) TRACK ONLY
NETHERWOOD
LELAND AVENUE
LEGEND:
EXISTING SIGNAL MAST
EXISTING SIGNAL BRIDGE
EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
EXISTING SIGNAL CASE
EXISTING PLATFORM
PROPOSED PLATFORM
EXISTING TRACK
PROPOSED TRACK
100 0 100 200
FEET
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012
No. DATE REVISION
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
SCENARIO 2
RARITAN VALLEY LINE MP 22.2 - 21.6
CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_02B
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 21.6 - 21.0

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_029
SHEET No.:

TO HIGH BRIDGE, NJ
TO NEWARK, NJ
REPLACE EXISTING WESTBOUND PLATFORM WITH NEW HIGH LEVEL PLATFORM ACCESSING OUTER (LOCAL) TRACK ONLY
FANWOOD
SCHEELENS CROSSING
MARTINE AVENUE

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL CASE
- EXISTING TRACK
- EXISTING SIGNAL BRIDGE
- EXISTING PLATFORM
- PROPOSED TRACK
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- PROPOSED PLATFORM

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

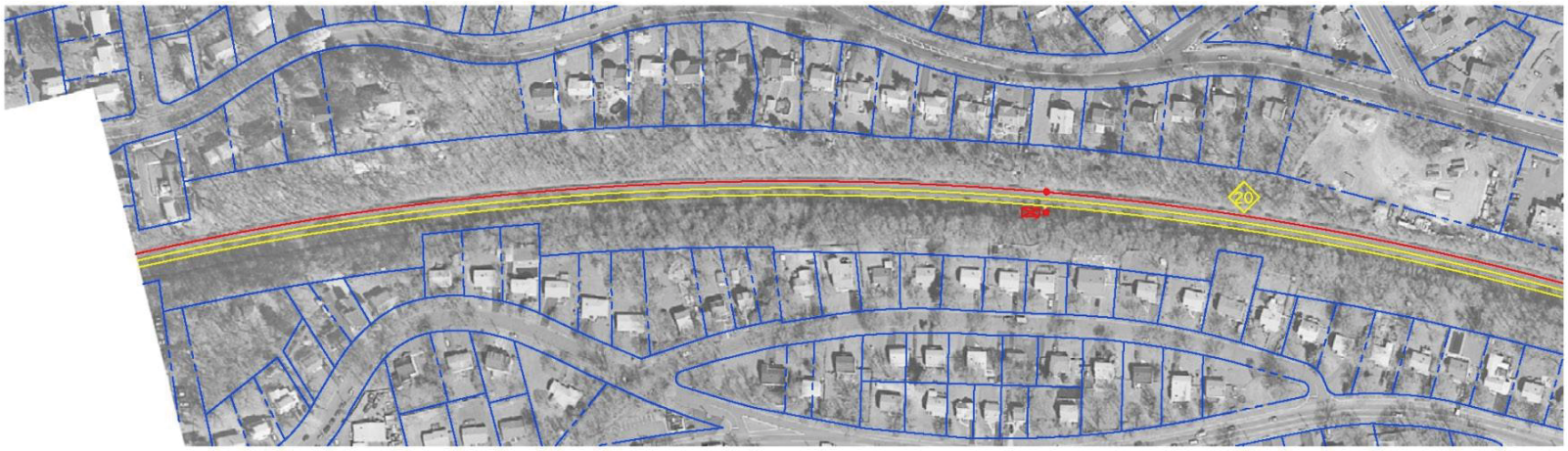
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 21.0 - 20.4

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_030
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 20.4 - 19.8

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_031
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

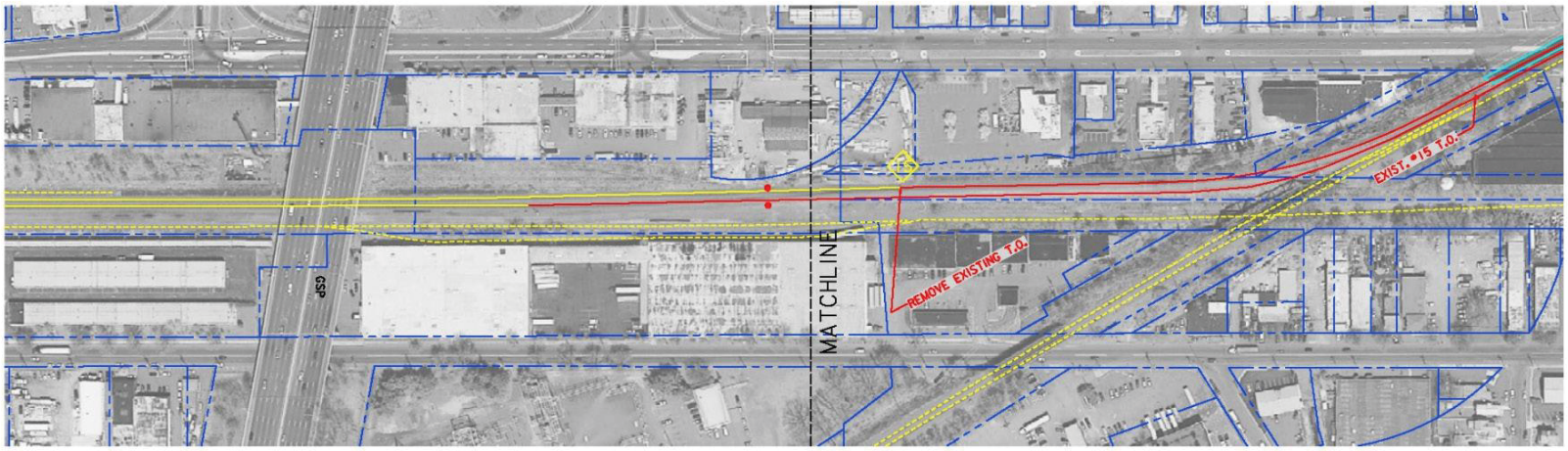
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 19.8 - 19.4

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_032
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 15.4-15.1

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_040
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

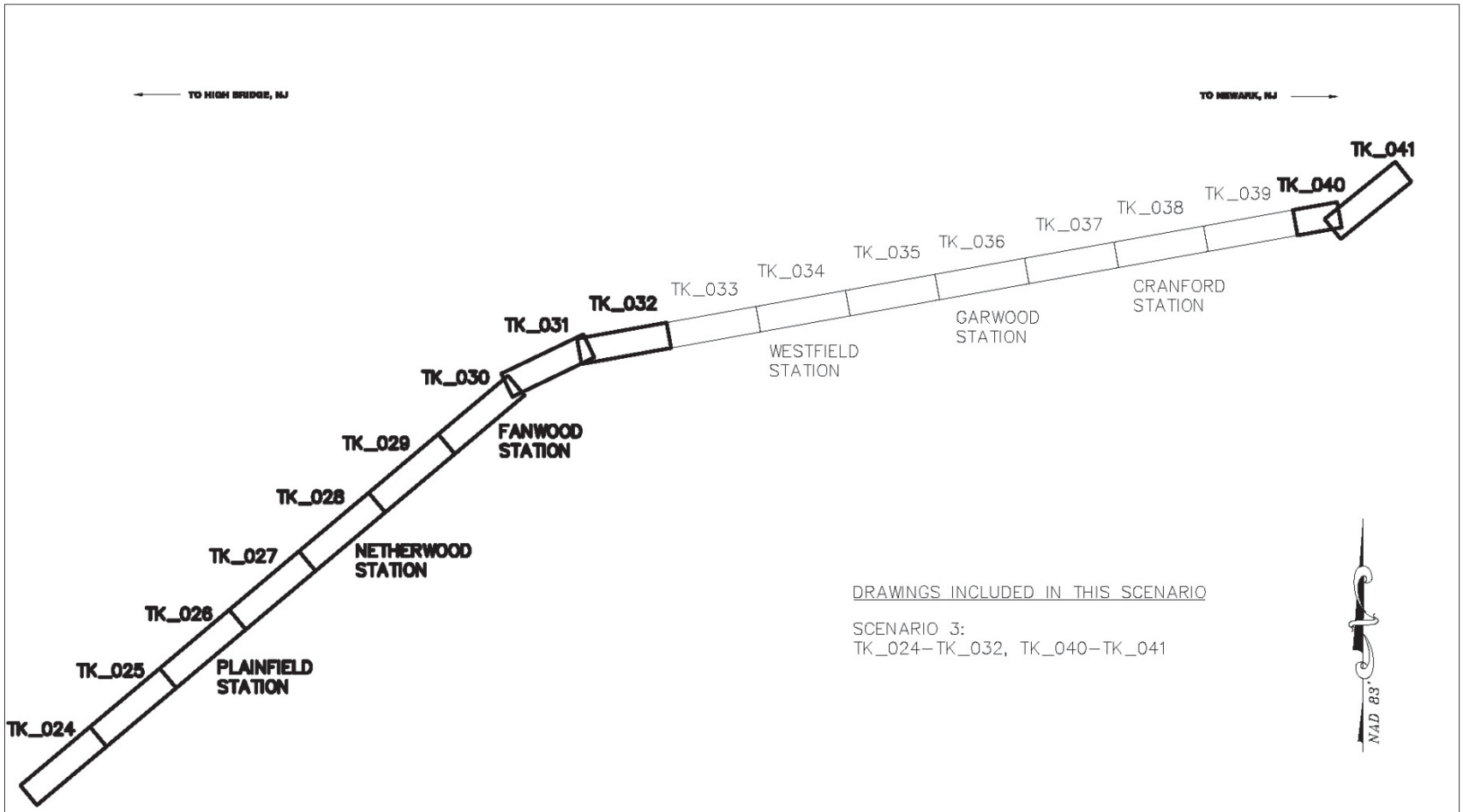
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 2

RARITAN VALLEY LINE MP 15.1-LEHIGH

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_041
SHEET No.:

Appendix F. Scenario 3 Alignment Drawings and Schematic


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
TK_024
TK_025
TK_026
TK_027
TK_028
TK_029
TK_030
TK_031
TK_032
TK_033
TK_034
TK_035
TK_036
TK_037
TK_038
TK_039
TK_040
TK_041
PLAINFIELD STATION
NETHERWOOD STATION
FANWOOD STATION
WESTFIELD STATION
GARWOOD STATION
CRANFORD STATION
DRAWINGS INCLUDED IN THIS SCENARIO
SCENARIO 3:
TK_024–TK_032, TK_040–TK_041
NAD 83
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012
No.
DATE
REVISION
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
KEY PLAN- SCENARIO 3
CONTRACT No.:
SCALE:
DRAWING No.:
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

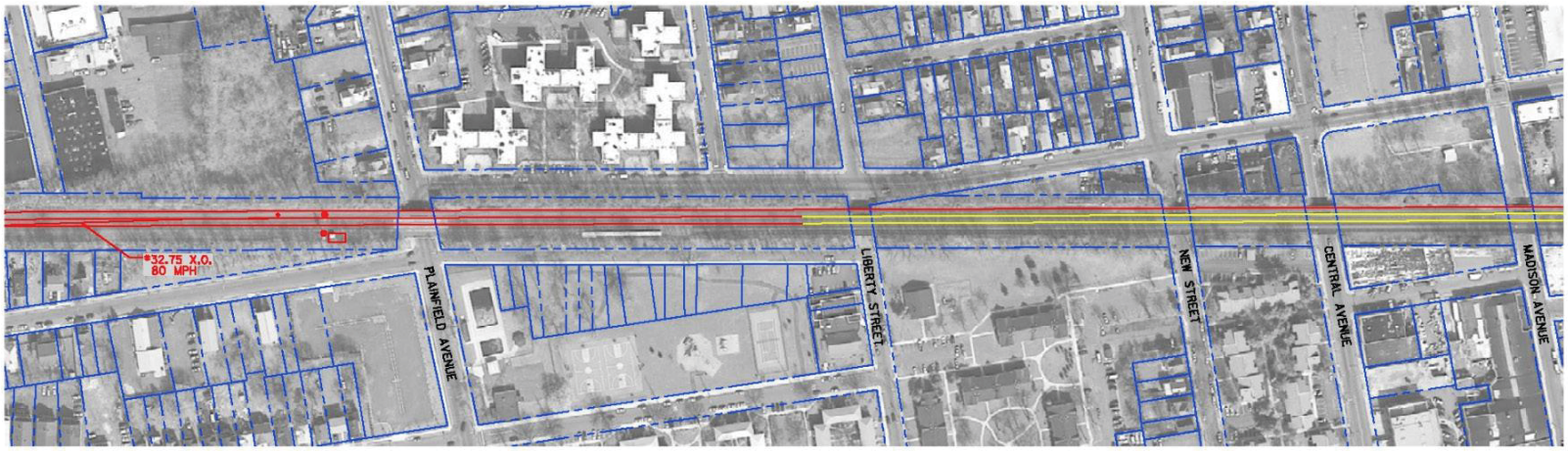
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 24.5-23.9

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_024
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

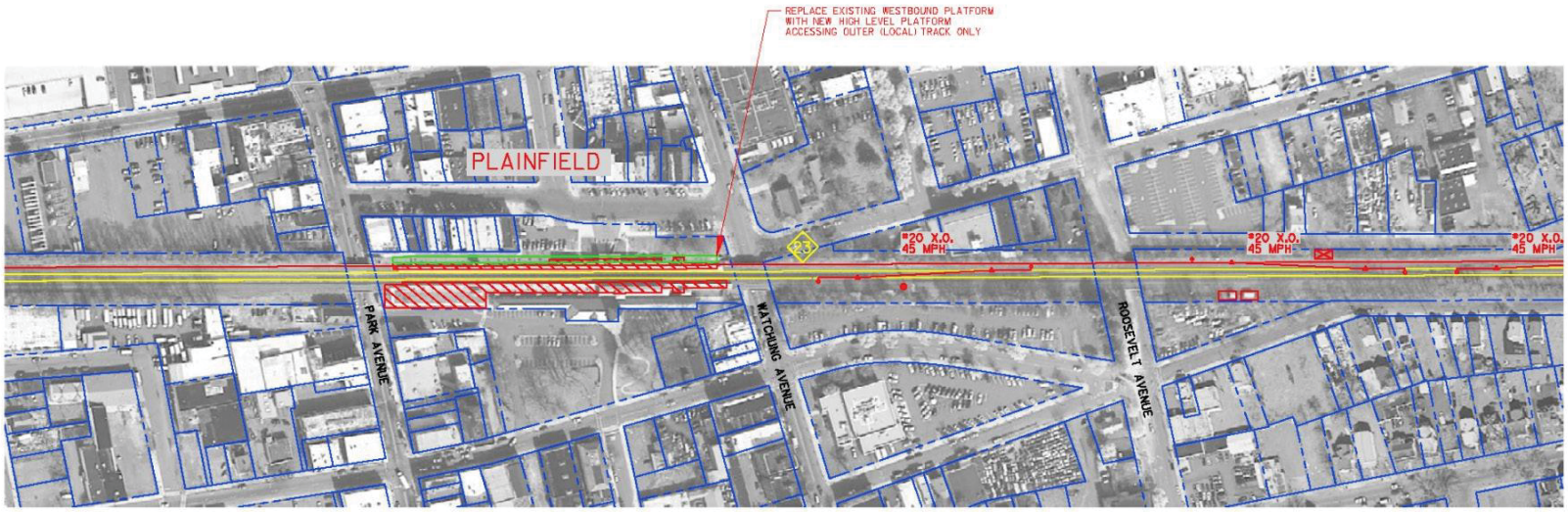
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 23.9 - 23.2

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_025
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200 FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 23.2 - 22.7

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_026
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

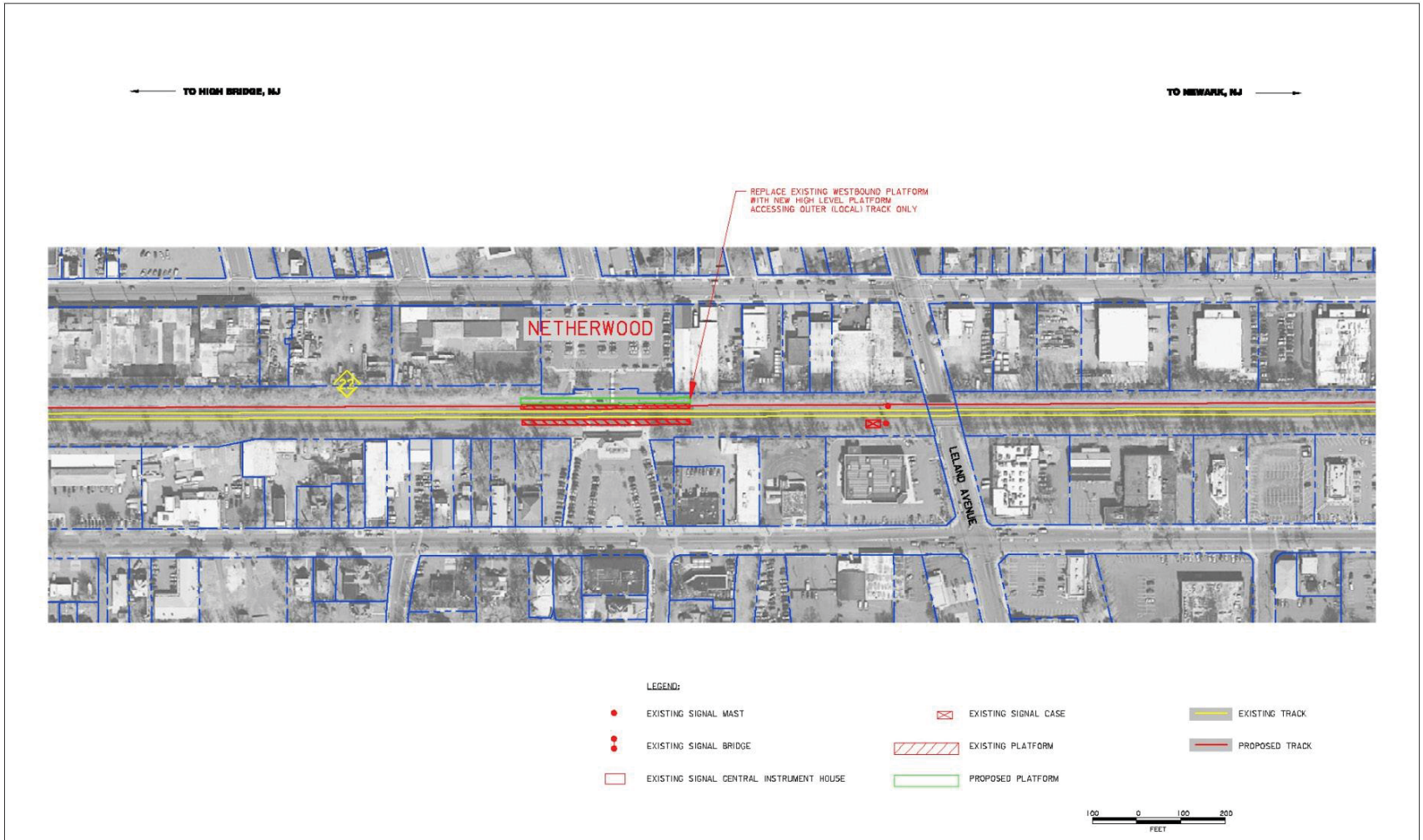
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

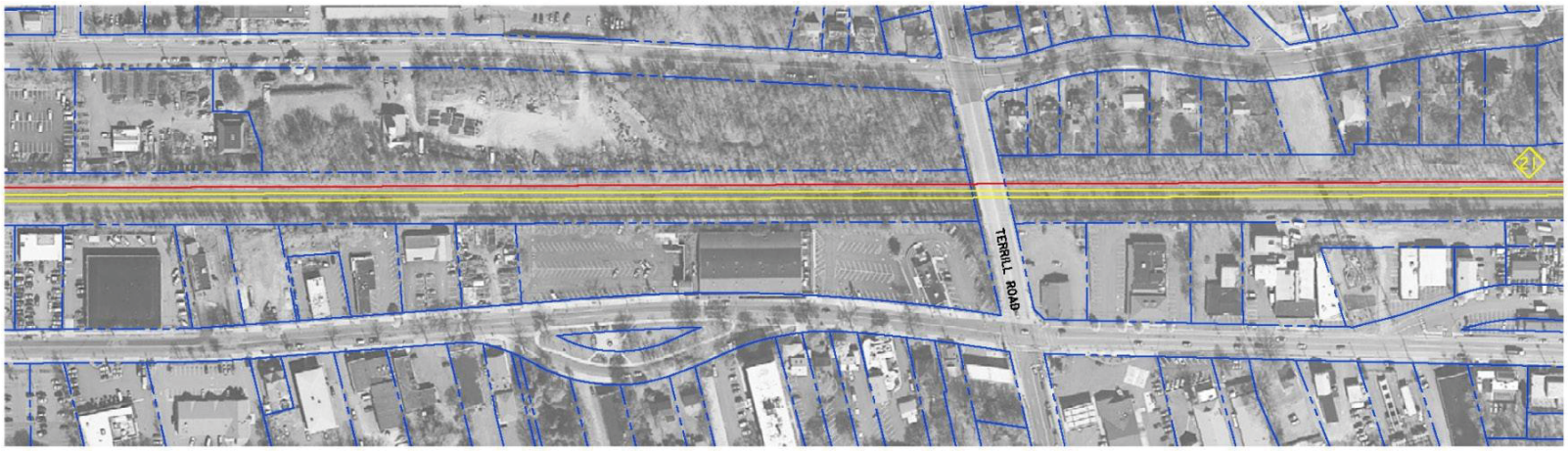
RARITAN VALLEY LINE MP 22.7 - 22.2

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_027
SHEET No.:


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
REPLACE EXISTING WESTBOUND PLATFORM WITH NEW HIGH LEVEL PLATFORM ACCESSING OUTER (LOCAL) TRACK ONLY
NETHERWOOD
LELAND AVENUE
LEGEND:
EXISTING SIGNAL MAST
EXISTING SIGNAL BRIDGE
EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
EXISTING SIGNAL CASE
EXISTING PLATFORM
PROPOSED PLATFORM
EXISTING TRACK
PROPOSED TRACK
100 0 100 200
FEET
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
DESIGNED
DRAWN
CHECKED
APPROVED
ISSUE DATE 11/14/2012
No. DATE REVISION
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
SCENARIO 3
RARITAN VALLEY LINE MP 22.2 - 21.6
CONTRACT No.
SCALE: 1"=100'
DRAWING No. TK_02B
SHEET No.

TO HIGH BRIDGE, NJ

TO NEWARK, NJ



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

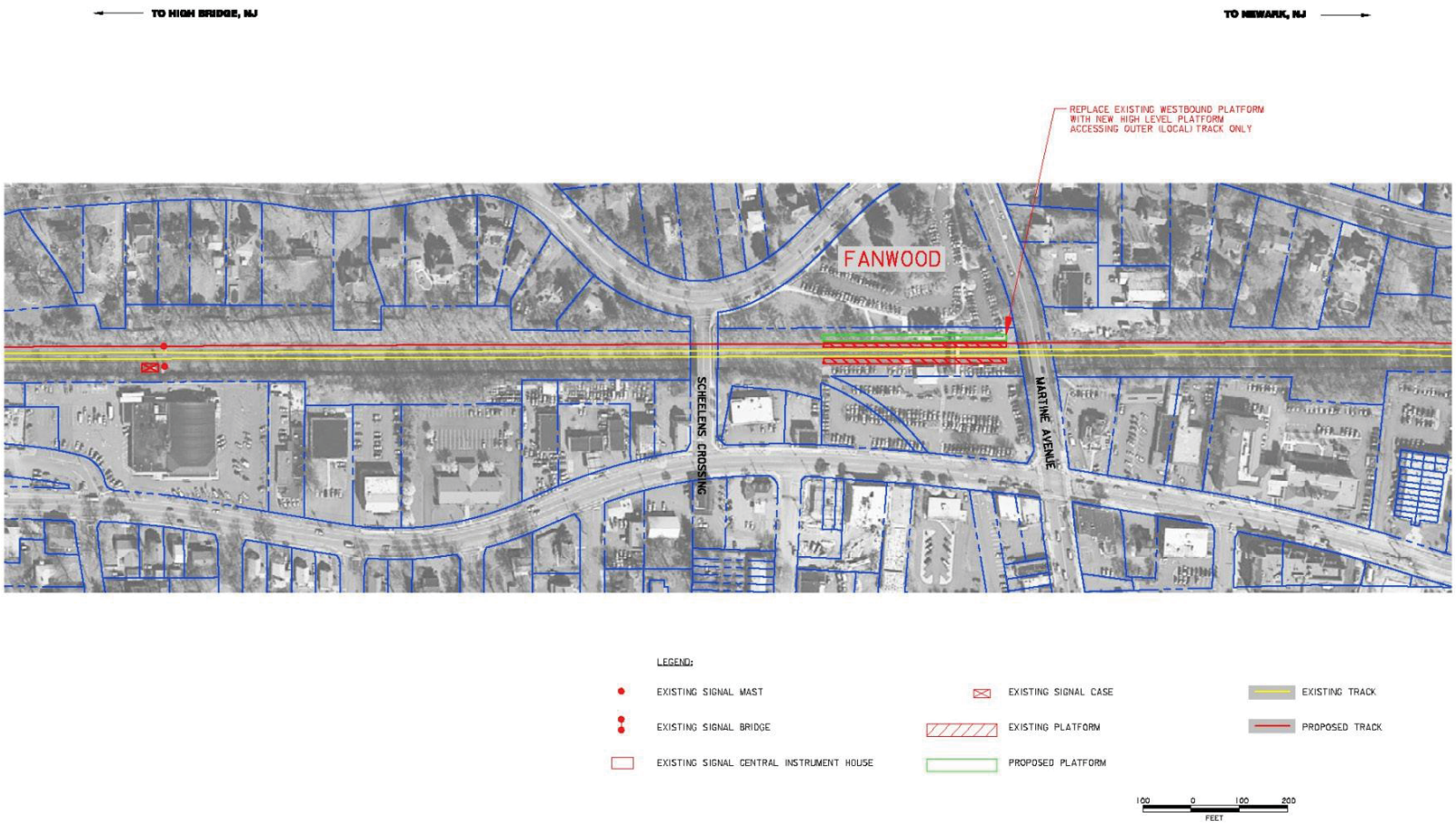
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

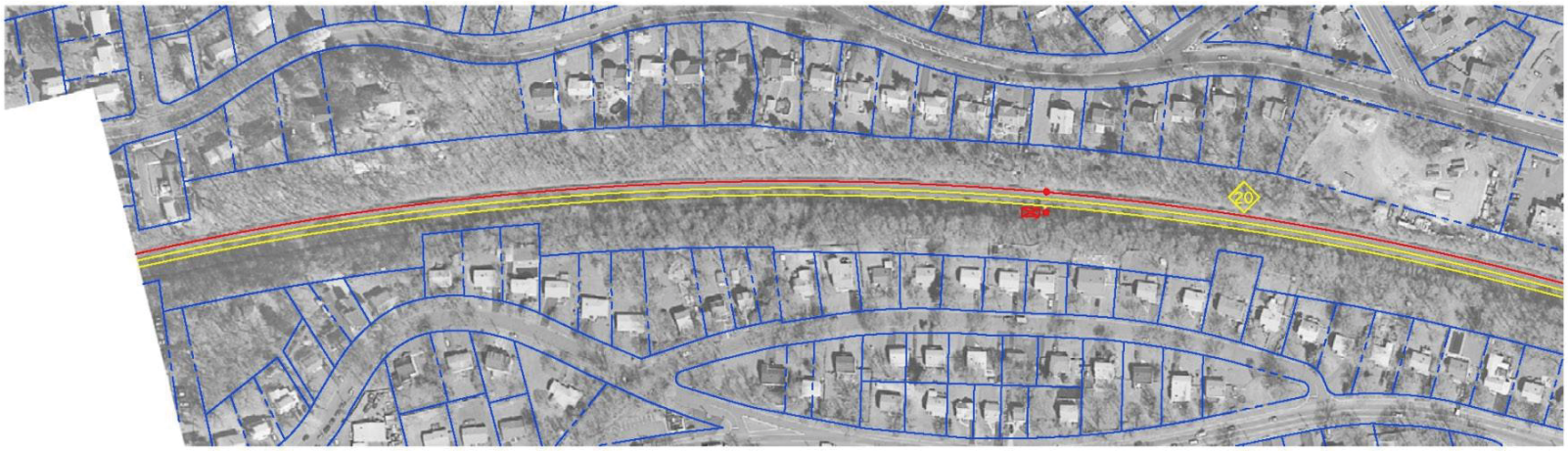
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 21.6 - 21.0

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_029
SHEET No.:


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
REPLACE EXISTING WESTBOUND PLATFORM WITH NEW HIGH LEVEL PLATFORM ACCESSING OUTER (LOCAL) TRACK ONLY
FANWOOD
SCHEELENS CROSSING
MARTINE AVENUE
LEGEND:
EXISTING SIGNAL MAST
EXISTING SIGNAL CASE
EXISTING TRACK
EXISTING SIGNAL BRIDGE
EXISTING PLATFORM
PROPOSED TRACK
EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
PROPOSED PLATFORM
100 0 100 200
FEET
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
No. DATE REVISION
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
SCENARIO 3
RARITAN VALLEY LINE MP 21.0 - 20.4
CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_030
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 20.4 - 19.8

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_031
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

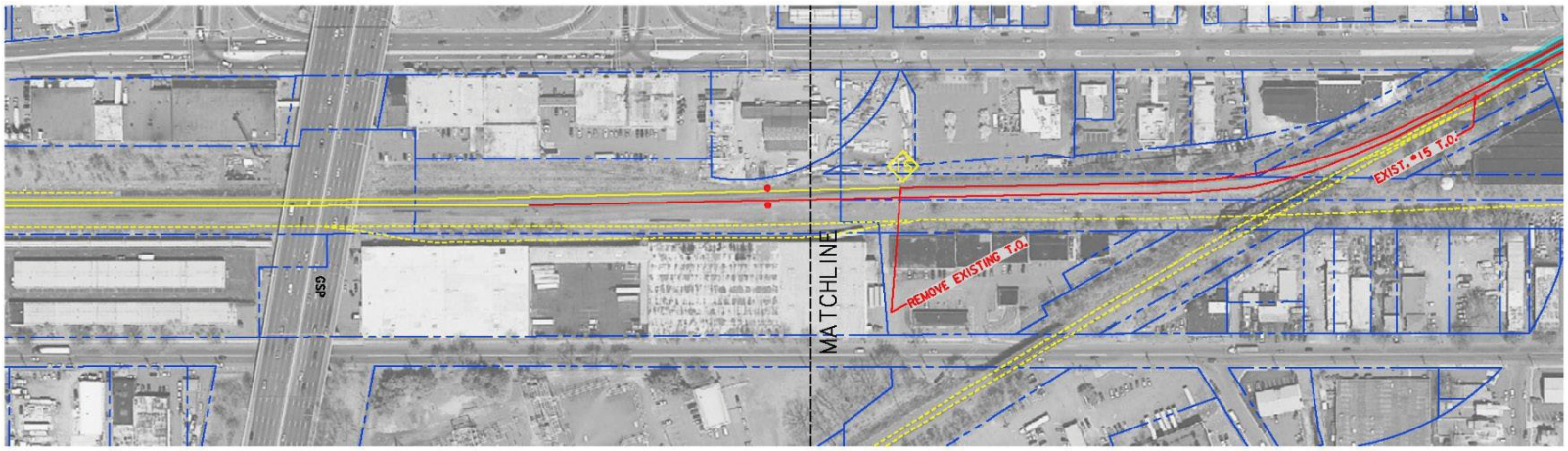
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 19.8 - 19.4

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_032
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 200
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 15.4-15.1

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_040
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07103

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

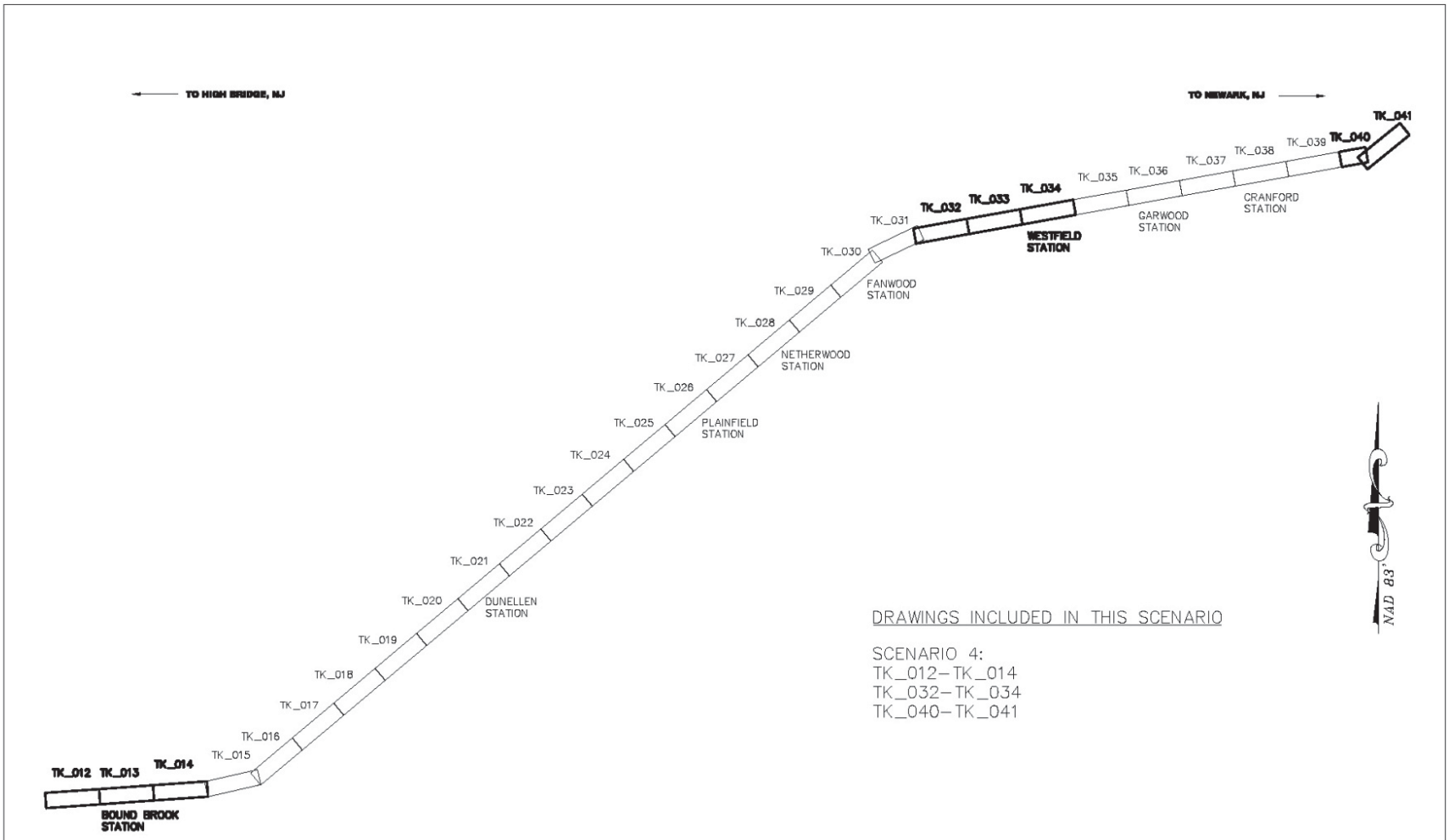
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 3

RARITAN VALLEY LINE MP 15.1-LEHIGH

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_041
SHEET No.:

Appendix G. Scenario 4 Alignment Drawings and Schematic


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
TK_012
TK_013
TK_014
TK_015
TK_016
TK_017
TK_018
TK_019
TK_020
TK_021
TK_022
TK_023
TK_024
TK_025
TK_026
TK_027
TK_028
TK_029
TK_030
TK_031
TK_032
TK_033
TK_034
TK_035
TK_036
TK_037
TK_038
TK_039
TK_040
TK_041
BOUND BROOK STATION
DUNELLEN STATION
PLAINFIELD STATION
NETHERWOOD STATION
FANWOOD STATION
WESTFIELD STATION
GARWOOD STATION
CRANFORD STATION
NAD 83'
DRAWINGS INCLUDED IN THIS SCENARIO
SCENARIO 4:
TK_012–TK_014
TK_032–TK_034
TK_040–TK_041
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012
No.
DATE
REVISION
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
KEY PLAN- SCENARIO 4
CONTRACT No.:
SCALE:
DRAWING No.:
SHEET No.:

TO HIGH BRIDGE, NJ

TO NEWARK, NJ

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

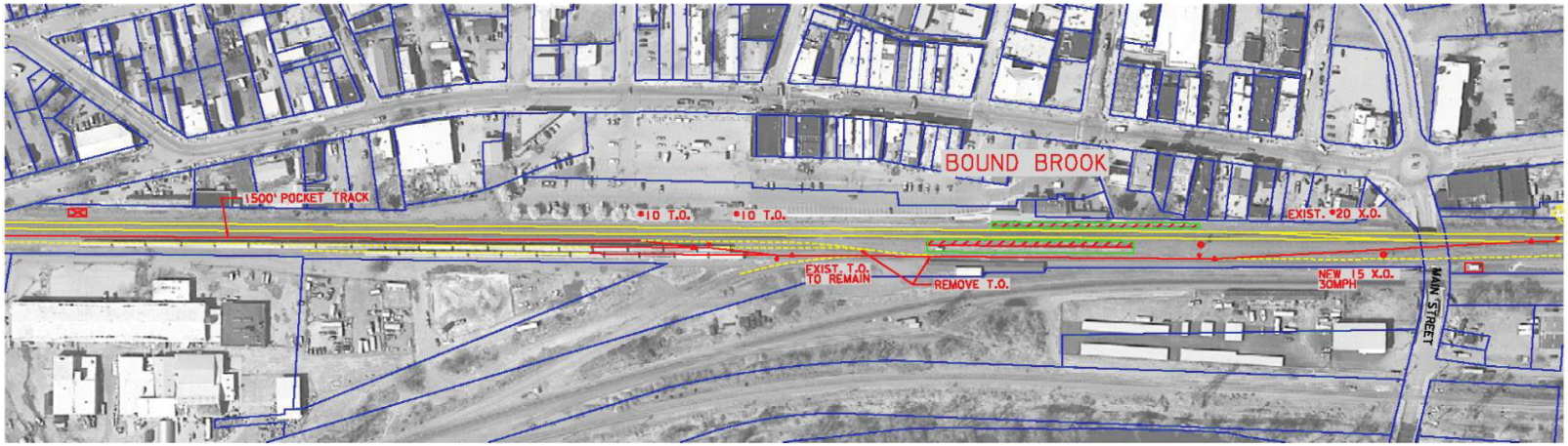
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4
RARITAN VALLEY LINE MP 31.2 - 30.6

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_012
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

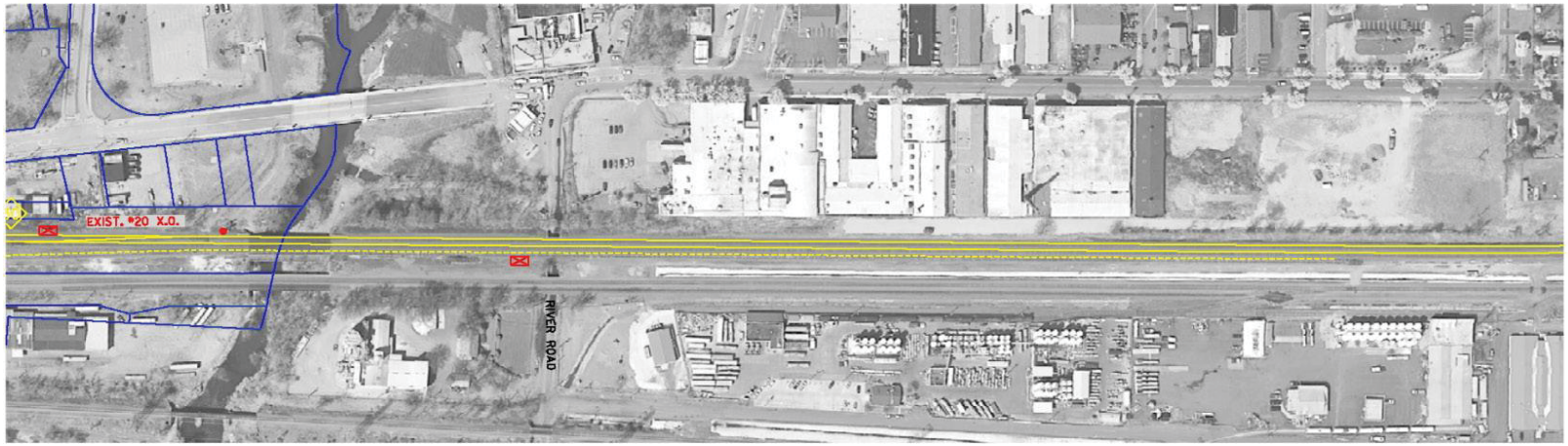
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4
RARITAN VALLEY LINE MP 30.6 - 30.0

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_013
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

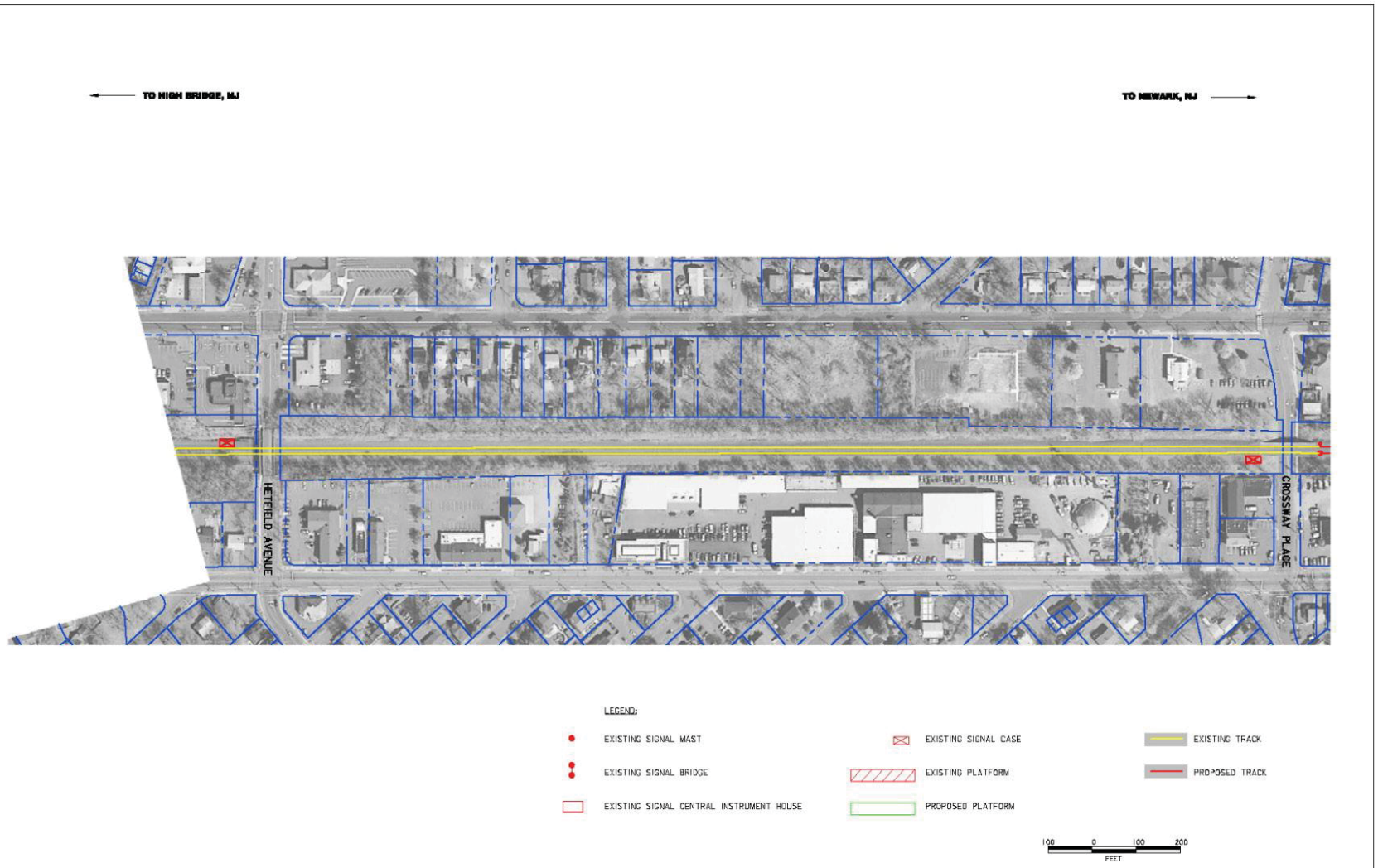
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

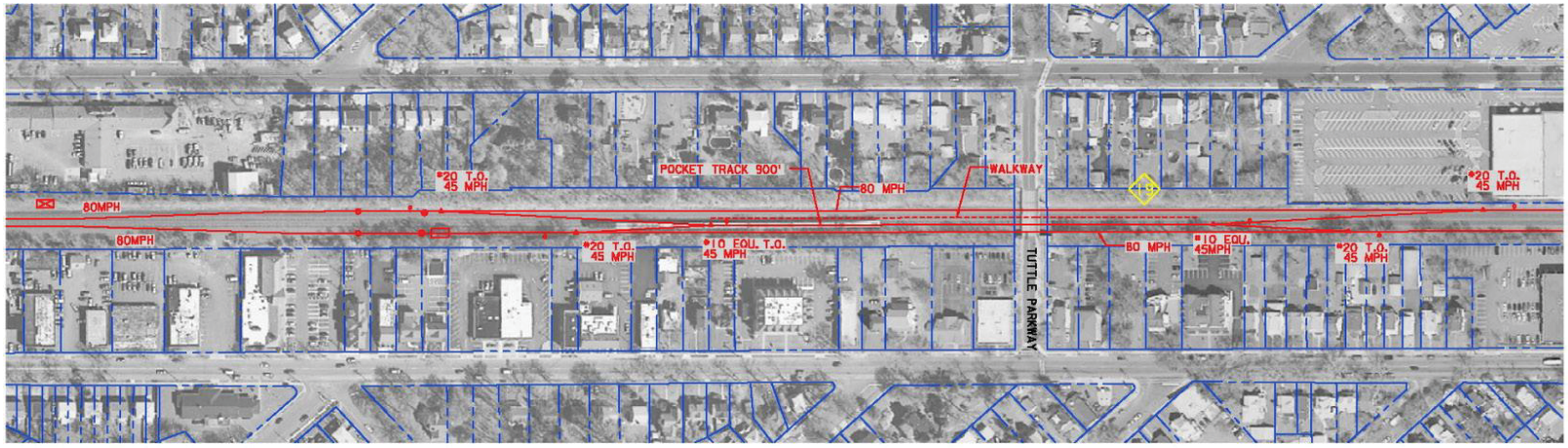
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4
RARITAN VALLEY LINE MP 30.0 - 29.5

CONTRACT No.:
SCALE: 1" = 100'
DRAWING No.: TK_014
SHEET No.:


TO HIGH BRIDGE, NJ
TO NEWARK, NJ
HETFIELD AVENUE
CROSSWAY PLACE
LEGEND:
EXISTING SIGNAL MAST
EXISTING SIGNAL BRIDGE
EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
EXISTING SIGNAL CASE
EXISTING PLATFORM
PROPOSED PLATFORM
EXISTING TRACK
PROPOSED TRACK
100 0 100 200
FEET
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
No. DATE REVISION
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY
SCENARIO 4
RARITAN VALLEY LINE MP 19.8 - 19.4
CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_032
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

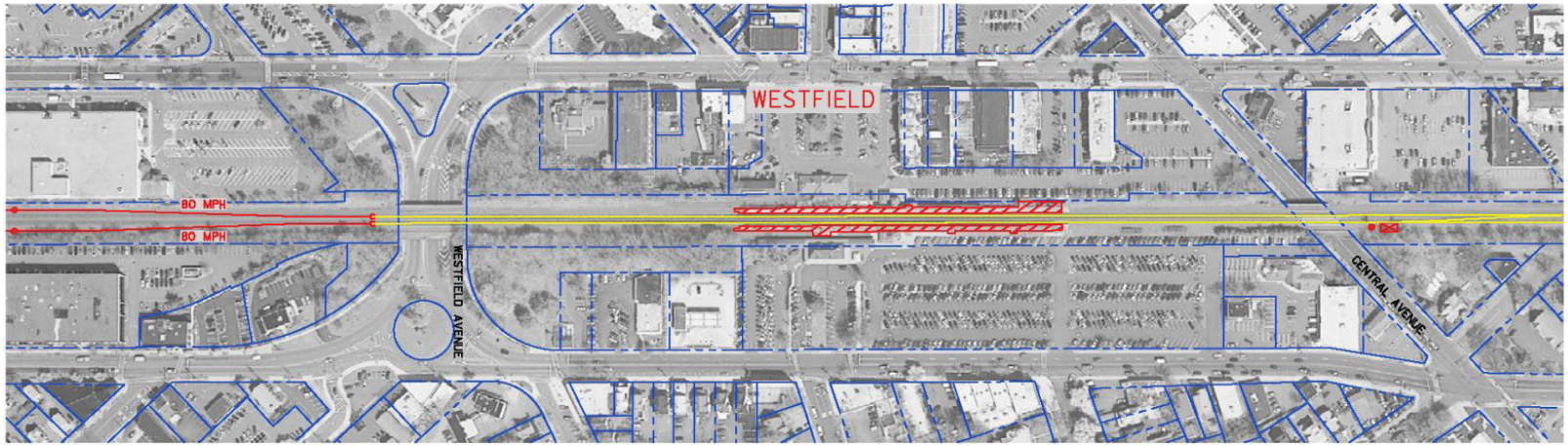
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4

RARITAN VALLEY LINE MP 19.4 - 18.8

CONTRACT No.:
SCALE: 1" = 100'
DRAWING No.: TK_033
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

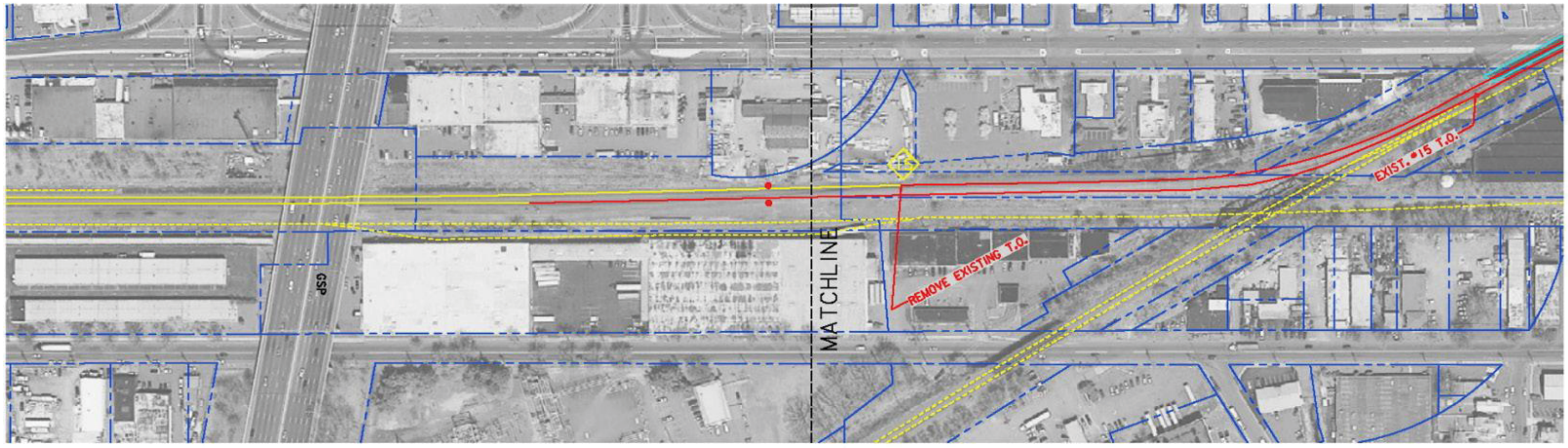
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4

RARITAN VALLEY LINE MP 18.8 - 18.3

CONTRACT No.:
SCALE: 1" = 100'
DRAWING No.: TK_034
SHEET No.:



LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4
RARITAN VALLEY LINE MP 15.4-15.1

CONTRACT No.:
SCALE: 1" = 100'
DRAWING No.: TK_040
SHEET No.:

LEGEND:

- EXISTING SIGNAL MAST
- EXISTING SIGNAL BRIDGE
- EXISTING SIGNAL CENTRAL INSTRUMENT HOUSE
- EXISTING SIGNAL CASE
- EXISTING PLATFORM
- PROPOSED PLATFORM
- EXISTING TRACK
- PROPOSED TRACK

100 0 100 200
FEET

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 11/14/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4
RARITAN VALLEY LINE MP 15.1-LEHIGH

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_041
SHEET No.:

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 01/17/2013

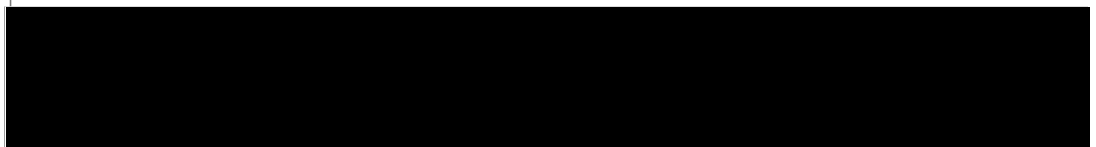
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4- DOUBLE TRACK ALDENE CONNECTION
80MPH MAS, WESTFIELD POCKET, BOUND BROOK 3RD TRACK

CONTRACT No.:
SCALE:
DRAWING No.: 7 of 8
SHEET No.:



NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 01/17/2013

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 4- DOUBLE TRACK ALDENE CONNECTION
80MPH MAS, WESTFIELD POCKET, BOUND BROOK 3RD TRACK

CONTRACT No.:
SCALE:
DRAWING No.: 8 of 8
SHEET No.:

Appendix H. Plainfield Turnback Drawings (Not Included in Any Scenario)

NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105

No.	DATE	REVISION

DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 07/17/2012

LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

SCENARIO 1
POCKET TRACK OPTION
RARITAN VALLEY LINE MP 23.9 - 23.2

CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_025
SHEET No.:

TO HIGH BRIDGE, NJ
TO NEWARK, NJ
100 0 100 200
FEET
DRAFT
NJTRANSIT
ONE PENN PLAZA EAST
NEWARK, NEW JERSEY 07105
No.
DATE
REVISION
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
ISSUE DATE: 07/17/2012
LTK
LTK ENGINEERING SERVICES
400 Market Street
Suite 300
Newark, NJ 07105
JACOBS
JACOBS ENGINEERING GROUP INC.
299 Madison Ave.
Morristown, NJ 07962
RARITAN VALLEY LINE THIRD TRACK
FEASIBILITY STUDY
SCENARIO 1
POCKET TRACK OPTION
RARITAN VALLEY LINE MP 23.2 - 22.7
CONTRACT No.:
SCALE: 1"=100'
DRAWING No.: TK_026
SHEET No.:

Appendix I. RVL Environmental Constraints

NJ TRANSIT

No.	DATE	REVISION	ISSUE DATE
			DESIGNED
			DRAWN
			CHECKED
			APPROVED

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

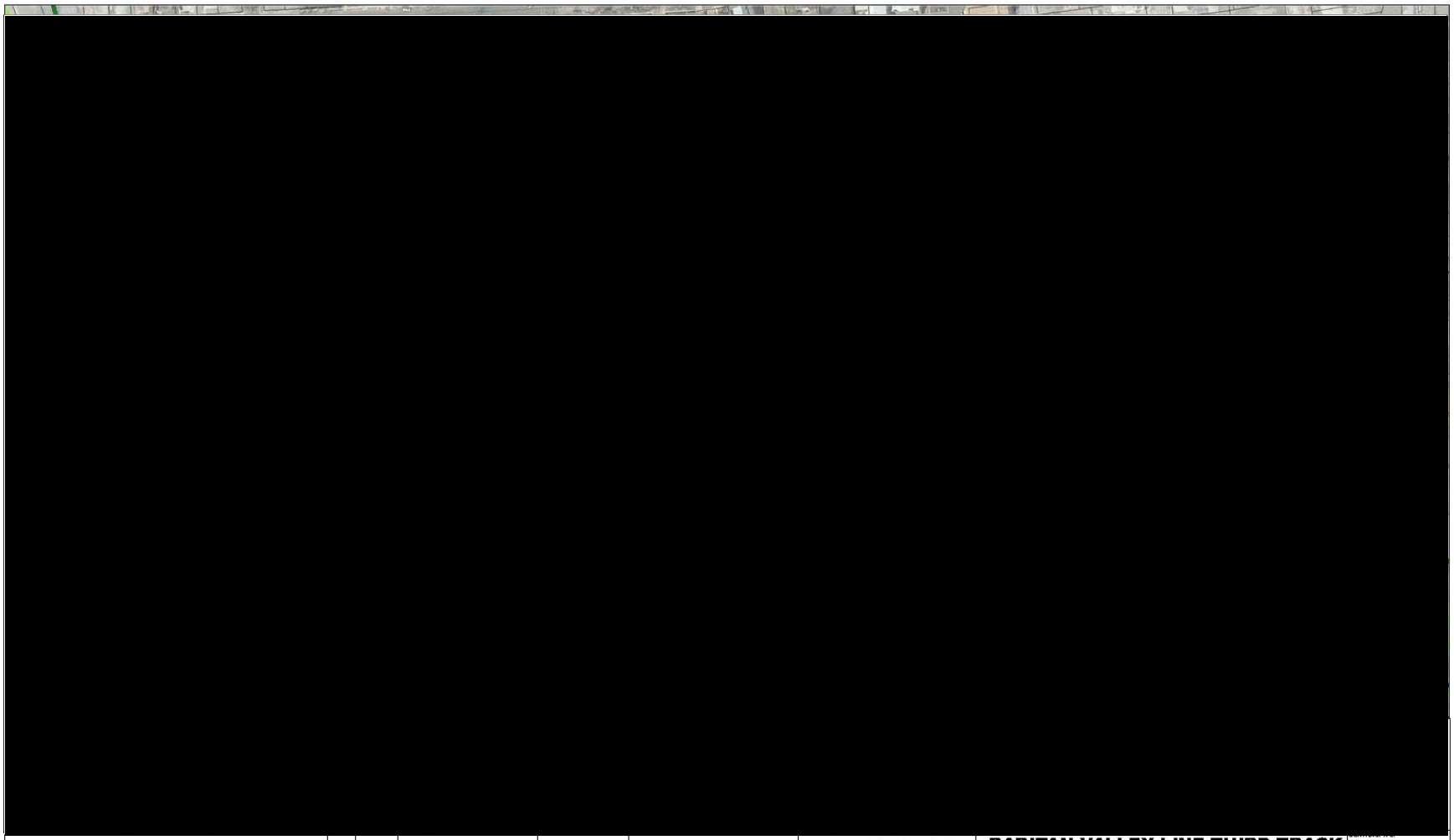
JACOBS
JACOBS ENGINEERING GROUP INC.
256 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS KEY MAP

CONTRACT NO.
SCALE
DRAWING NO.
SHEET NO.

Path: J:\2012 Projects\CSX\936000\Documents\60001SC\605GIS\mxd\cover_sheet_Worker_plans_NJT_Raritan_Alignment.mxd



NJ TRANSIT

No.	DATE	REVISION	
			DESIGNED
			DRAWN
			CHECKED
			APPROVED
			ISSUE DATE

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
259 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK
FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

SCALE: 1" = 200'

DRAWING NO.

SHEET NO. SHEET - 12

Path: J:\2012 Projects\C9X98600\Documents\60001SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT				DESIGNED.	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.		SCALE 1" = 200'
				CHECKED.	ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.		SHEET NO. SHEET - 13
	No.	DATE	REVISION	ISSUE DATE.		

LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

Path: J:\2012 Projects\C2012600\Documents\600\ISC\605\GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION	ISSUE DATE
			DESIGNED
			DRAWN
			CHECKED
			APPROVED

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

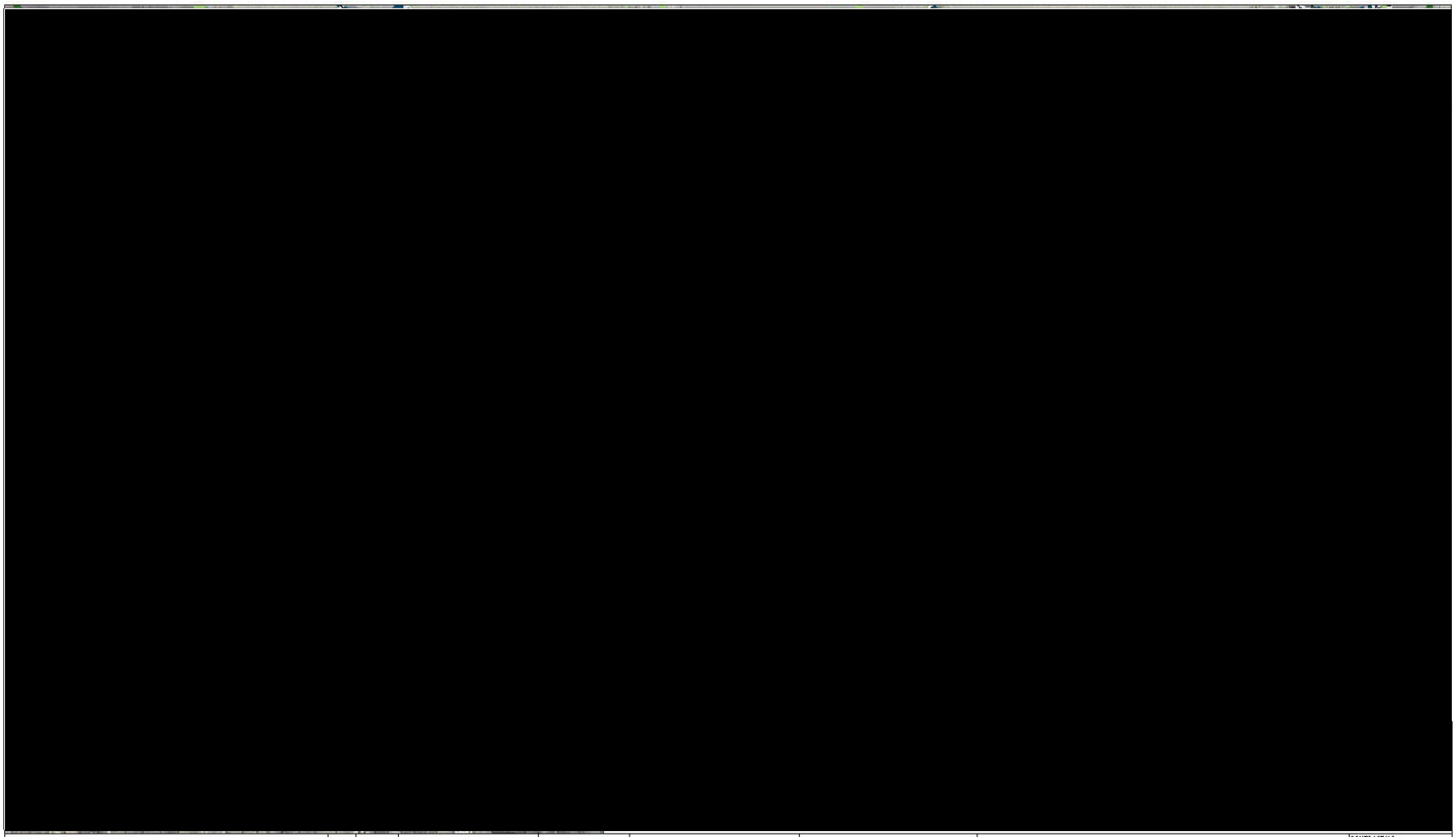
JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 14

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd



NJ TRANSIT				DESIGNED.	LTK ENGINEERING SERVICES 400 MARKET STREET SUITE 500 NEWARK, NJ 07105	JACOBS JACOBS ENGINEERING GROUP INC. 255 MADISON AV. MORRISTOWN, NJ 07962	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.				SCALE 1" = 200'
				CHECKED.			ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.				SHEET NO. SHEET - 24
	No.	DATE	REVISION	ISSUE DATE.				

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT				DESIGNED.	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.		SCALE 1" = 200'
				CHECKED.	ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.		SHEET NO. SHEET - 25
	No.	DATE	REVISION	ISSUE DATE.		

LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

Path: J:\2012 Projects\C29X986000\Documents\600\ISC\605\GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT				DESIGNED.	LTK ENGINEERING SERVICES 400 MARKET STREET SUITE 500 NEWARK, NJ 07105
				DRAWN.	
				CHECKED.	JACOBS ENGINEERING GROUP INC. 255 MADISON AV. MORRISTOWN, NJ 07962
				APPROVED.	
	No.	DATE	REVISION	ISSUE DATE.	

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.

SCALE 1" = 200'

DRAWING NO.

SHEET NO. SHEET - 26

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION

DESIGNED.
DRAWN.
CHECKED.
APPROVED.
ISSUE DATE.

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

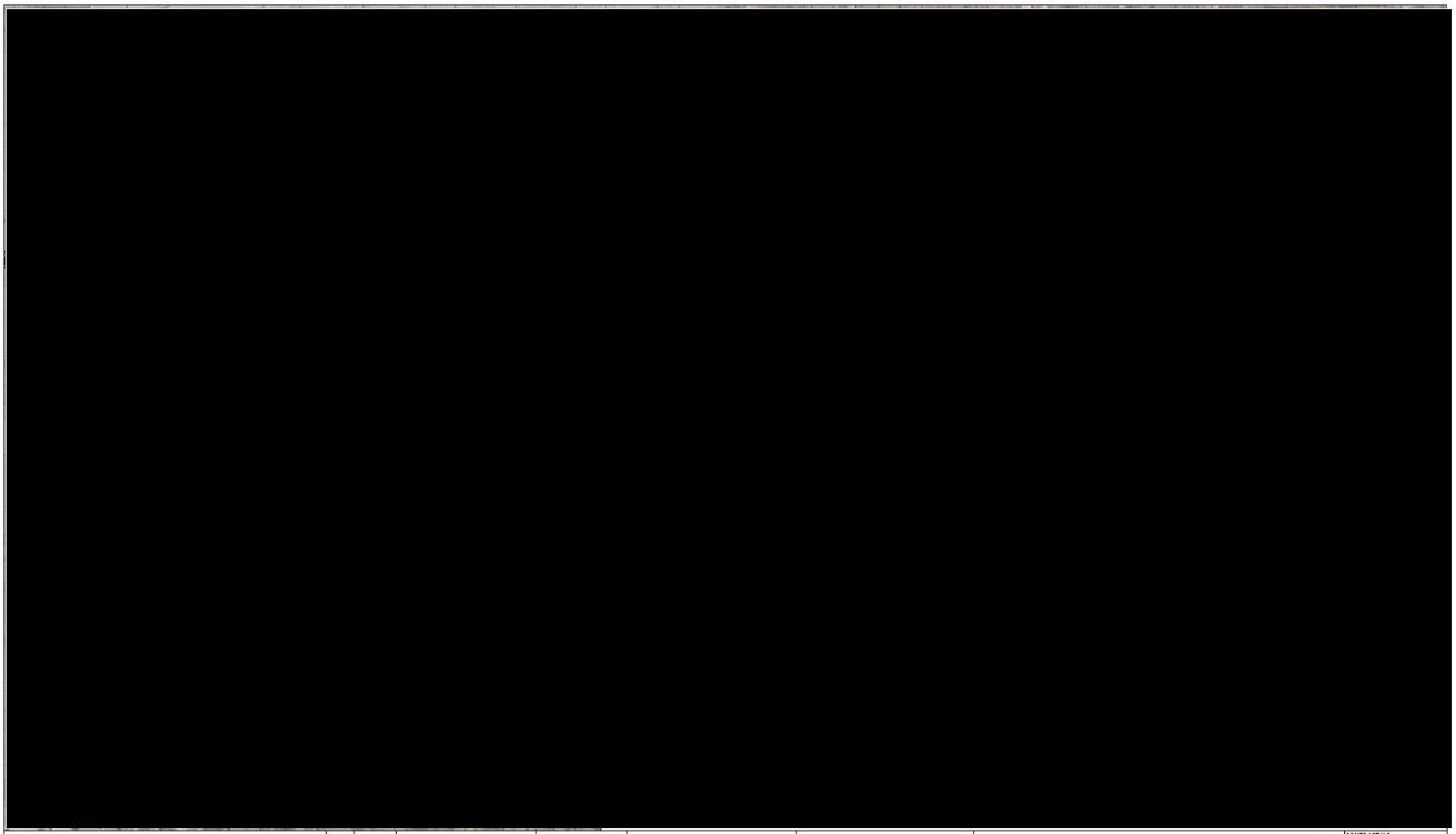
JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 27

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd



NJ TRANSIT				DESIGNED.	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.		SCALE 1" = 200'
				CHECKED.	ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.		SHEET NO. SHEET - 28
	No.	DATE	REVISION	ISSUE DATE.		

LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

Path: J:\2012 Projects\C2012S6000\Documents\6000ISC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION	ISSUE DATE
			DESIGNED
			DRAWN
			CHECKED
			APPROVED

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

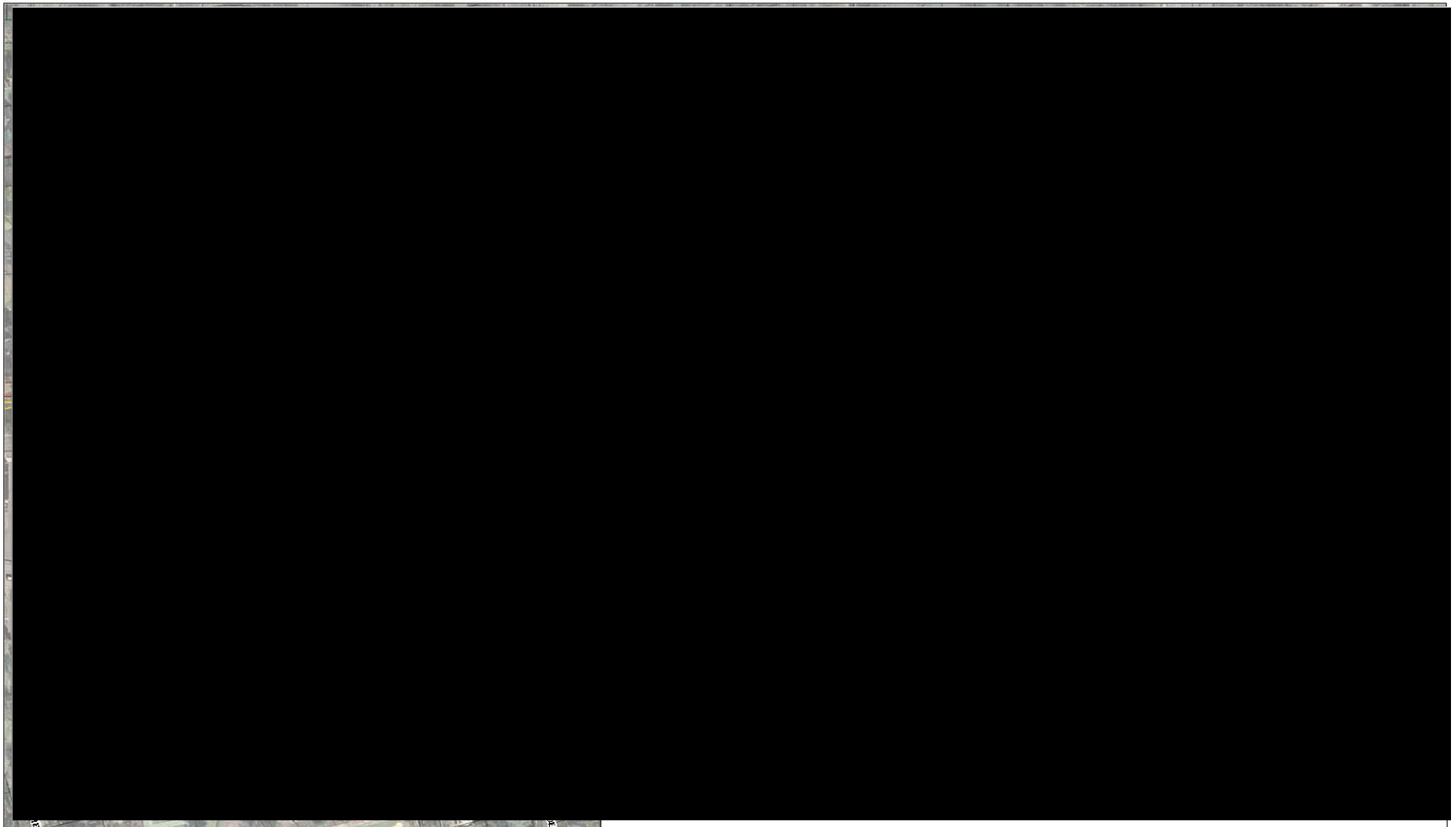
JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK
FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

SCALE: 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 29

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd



NJ TRANSIT

No.	DATE	REVISION	
			DESIGNED
			DRAWN
			CHECKED
			APPROVED
			ISSUE DATE

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 30

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION	ISSUE DATE
			DESIGNED
			DRAWN
			CHECKED
			APPROVED

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK
FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 31

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION

DESIGNED.
DRAWN.
CHECKED.
APPROVED.
ISSUE DATE.

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 32

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT				DESIGNED.	LTK ENGINEERING SERVICES 400 MARKET STREET SUITE 500 NEWARK, NJ 07105	JACOBS ENGINEERING GROUP INC. 255 MADISON AV. MORRISTOWN, NJ 07962	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.				SCALE 1" = 200'
				CHECKED.			ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.				SHEET NO. SHEET - 33
	No.	DATE	REVISION	ISSUE DATE.				

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT				DESIGNED.	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.		SCALE 1" = 200'
				CHECKED.	ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.		SHEET NO. SHEET - 34
	No.	DATE	REVISION	ISSUE DATE.		

LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

Path: J:\2012 Projects\C29X986000\Documents\600\ISC\605\GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

NJ TRANSIT

No.	DATE	REVISION	
			DESIGNED
			DRAWN
			CHECKED
			APPROVED
			ISSUE DATE

LTK
LTK ENGINEERING SERVICES
400 MARKET STREET
SUITE 500
NEWARK, NJ 07105

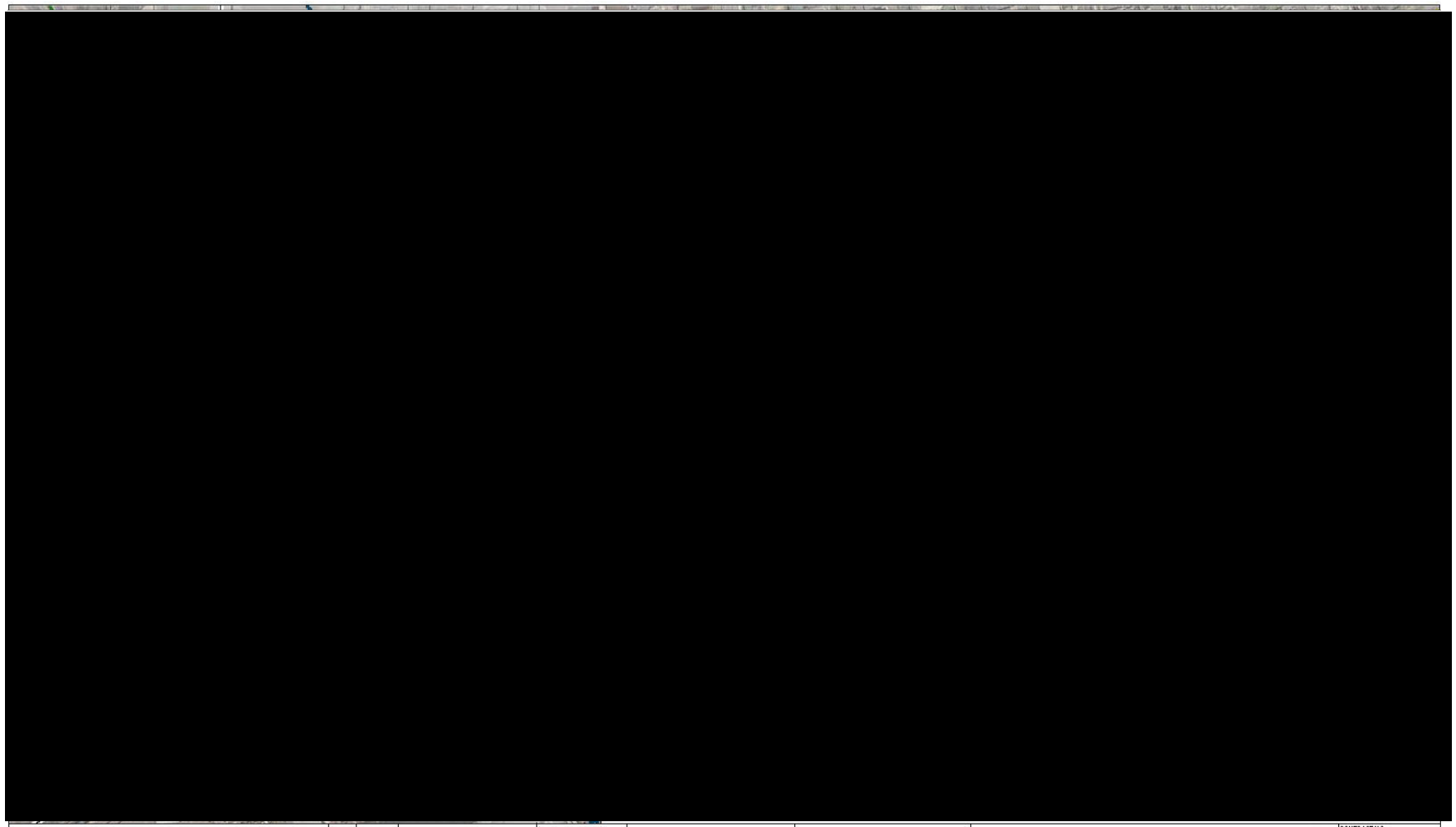
JACOBS
JACOBS ENGINEERING GROUP INC.
255 MADISON AV.
MORRISTOWN, NJ 07962

RARITAN VALLEY LINE THIRD TRACK
FEASIBILITY STUDY

ENVIRONMENTAL CONSTRAINTS

CONTRACT NO.
SCALE 1" = 200'
DRAWING NO.
SHEET NO. SHEET - 40

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd



NJ TRANSIT				DESIGNED.	LTK ENGINEERING SERVICES 400 MARKET STREET SUITE 500 NEWARK, NJ 07105	JACOBS JACOBS ENGINEERING GROUP INC. 255 MADISON AV. MORRISTOWN, N J 07962	RARITAN VALLEY LINE THIRD TRACK FEASIBILITY STUDY	CONTRACT NO.
				DRAWN.				SCALE 1" = 200'
				CHECKED.			ENVIRONMENTAL CONSTRAINTS	DRAWING NO.
				APPROVED.				SHEET NO. SHEET - 41
	No.	DATE	REVISION	ISSUE DATE.				

Path: J:\2012 Projects\C29X986000\Documents\60003SC\605GIS\mxd\Worker_plans_gray_hatch_NJT_Raritan_Alignment.mxd

Appendix J. Scenario 1 Time-Distance ("String") Chart Simulation Results

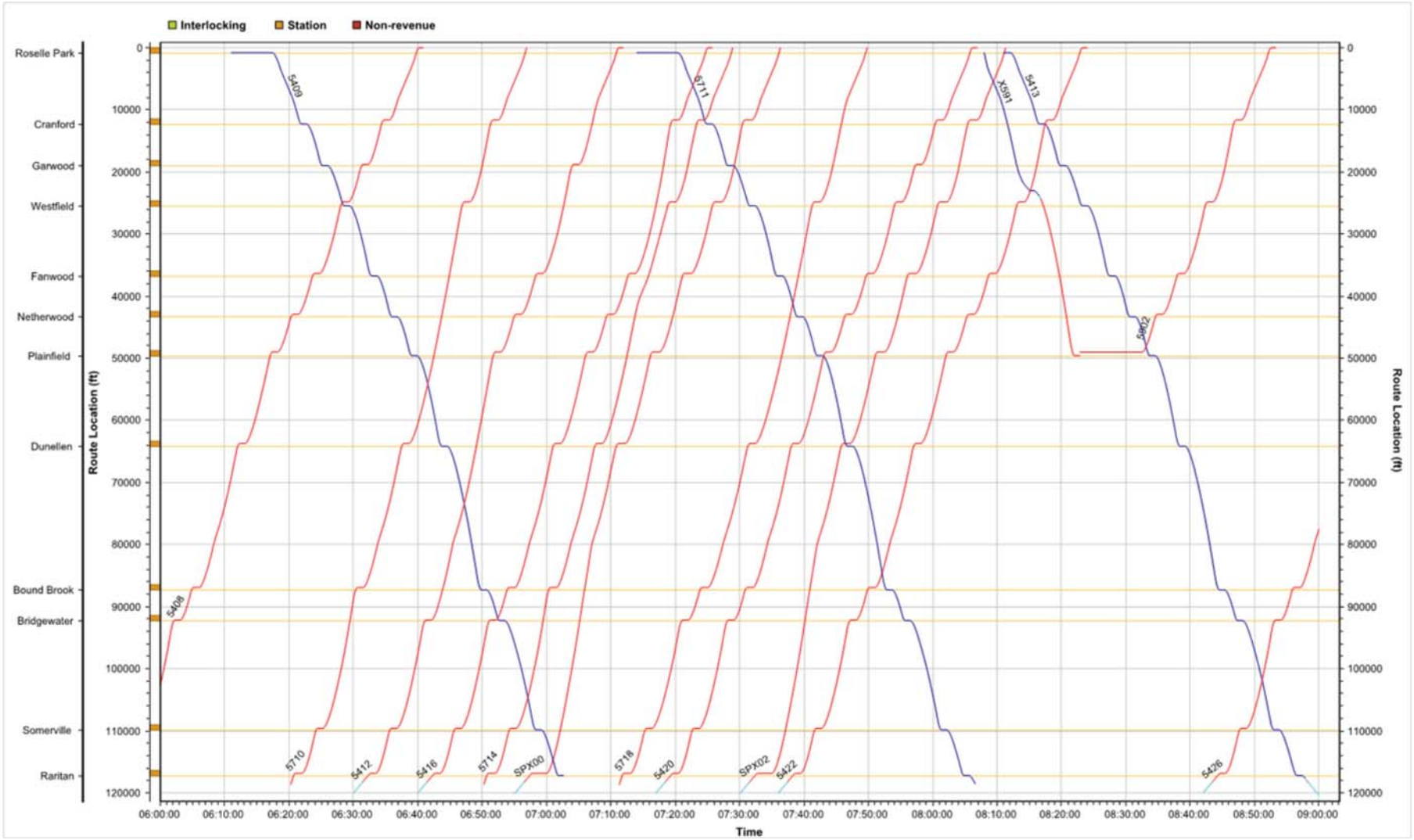


Figure 6 – Scenario 1 AM Time-Distance "String Chart"

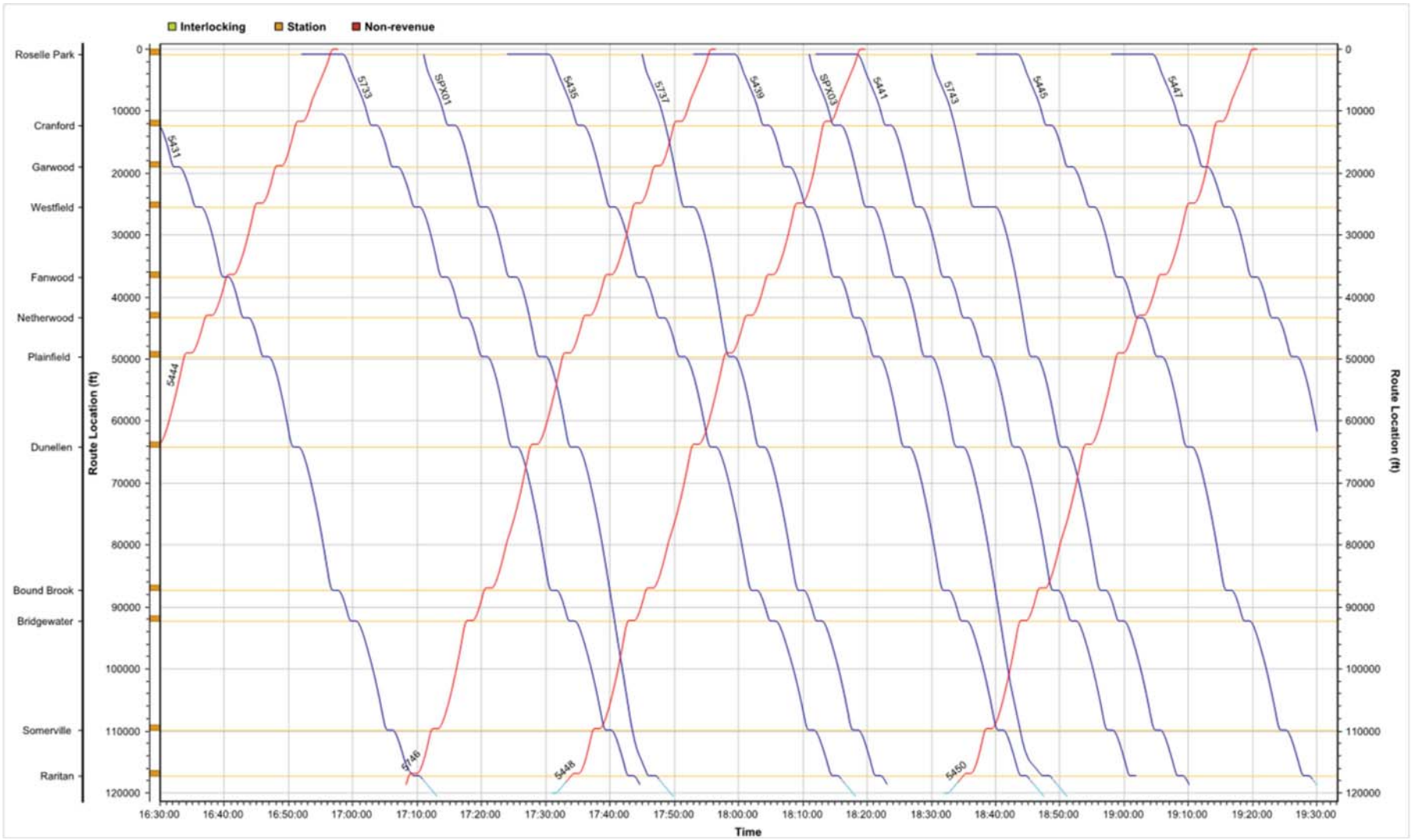


Figure 7 – Scenario 1 PM Time-Distance "String Chart"

Appendix K. Scenario 2 Time-Distance ("String") Chart Simulation Results

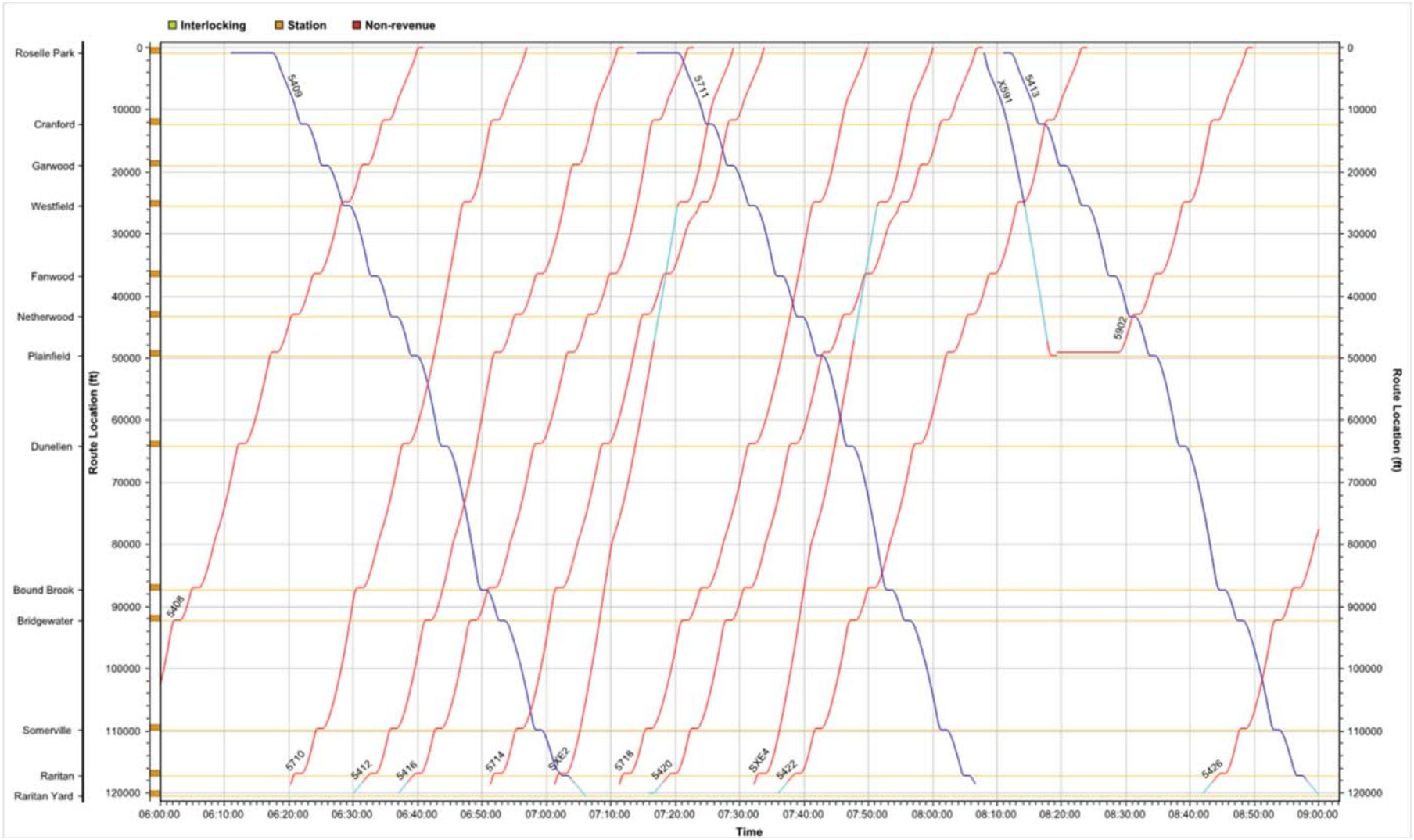


Figure 8 – Scenario 2 AM Time Distance "String Chart"

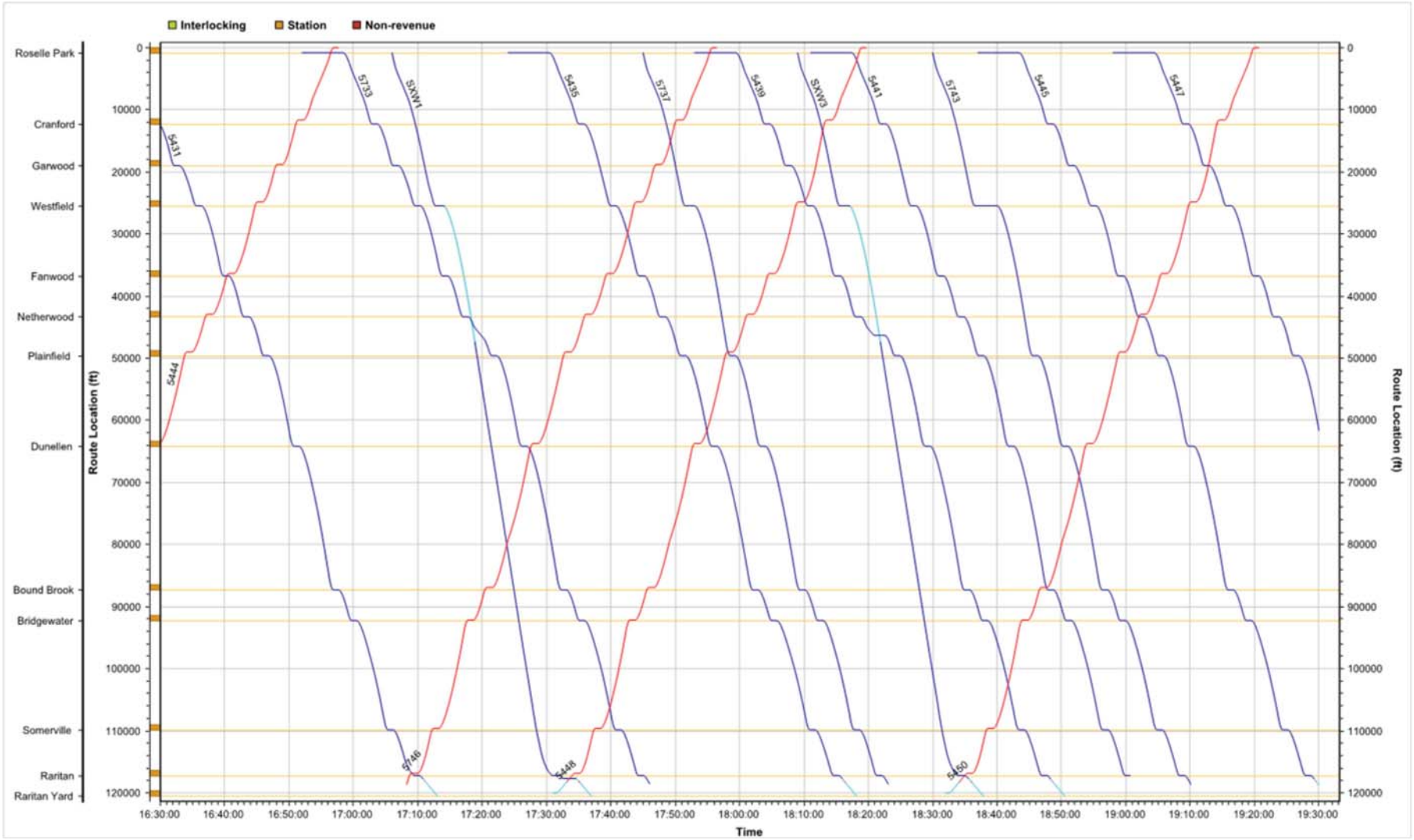


Figure 9 – Scenario 2 PM Time Distance "String Chart"

Appendix L. Scenario 3 Time-Distance ("String") Chart Simulation Results

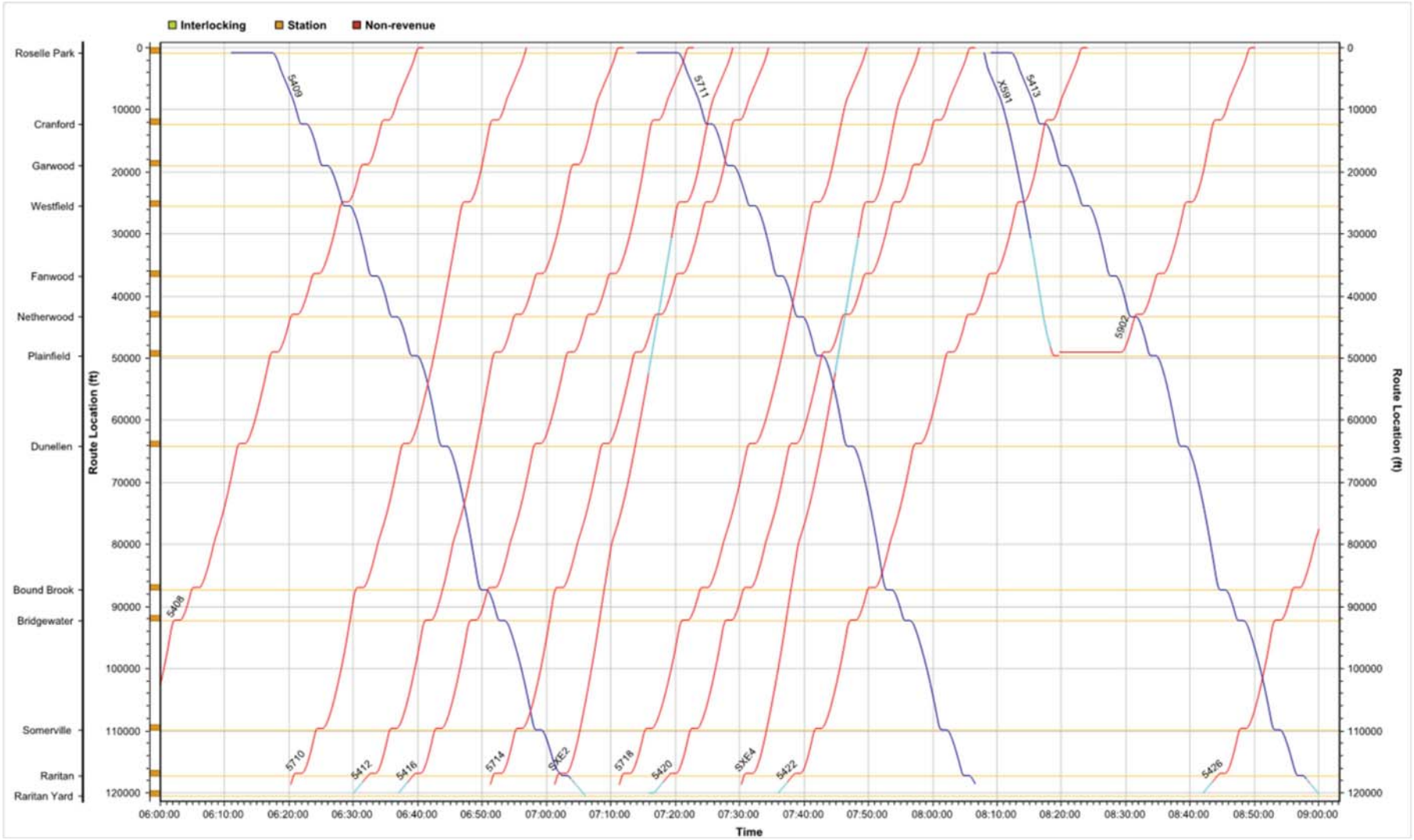


Figure 10 – Scenario 3 AM Time Distance "String Chart"

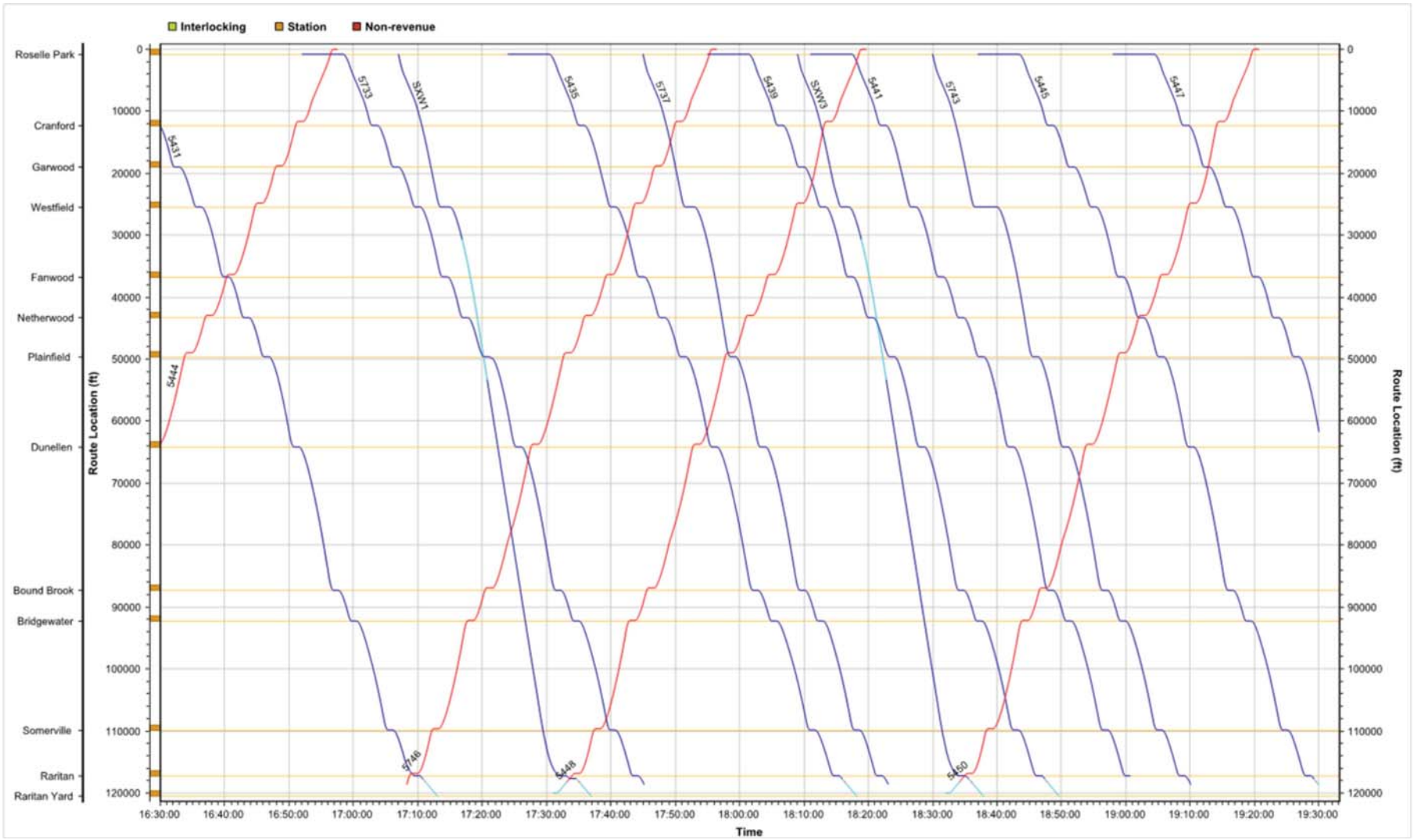


Figure 11 – Scenario 3 PM Time Distance "String Chart"

Appendix M. Scenario 4 Time-Distance ("String") Chart Simulation Results

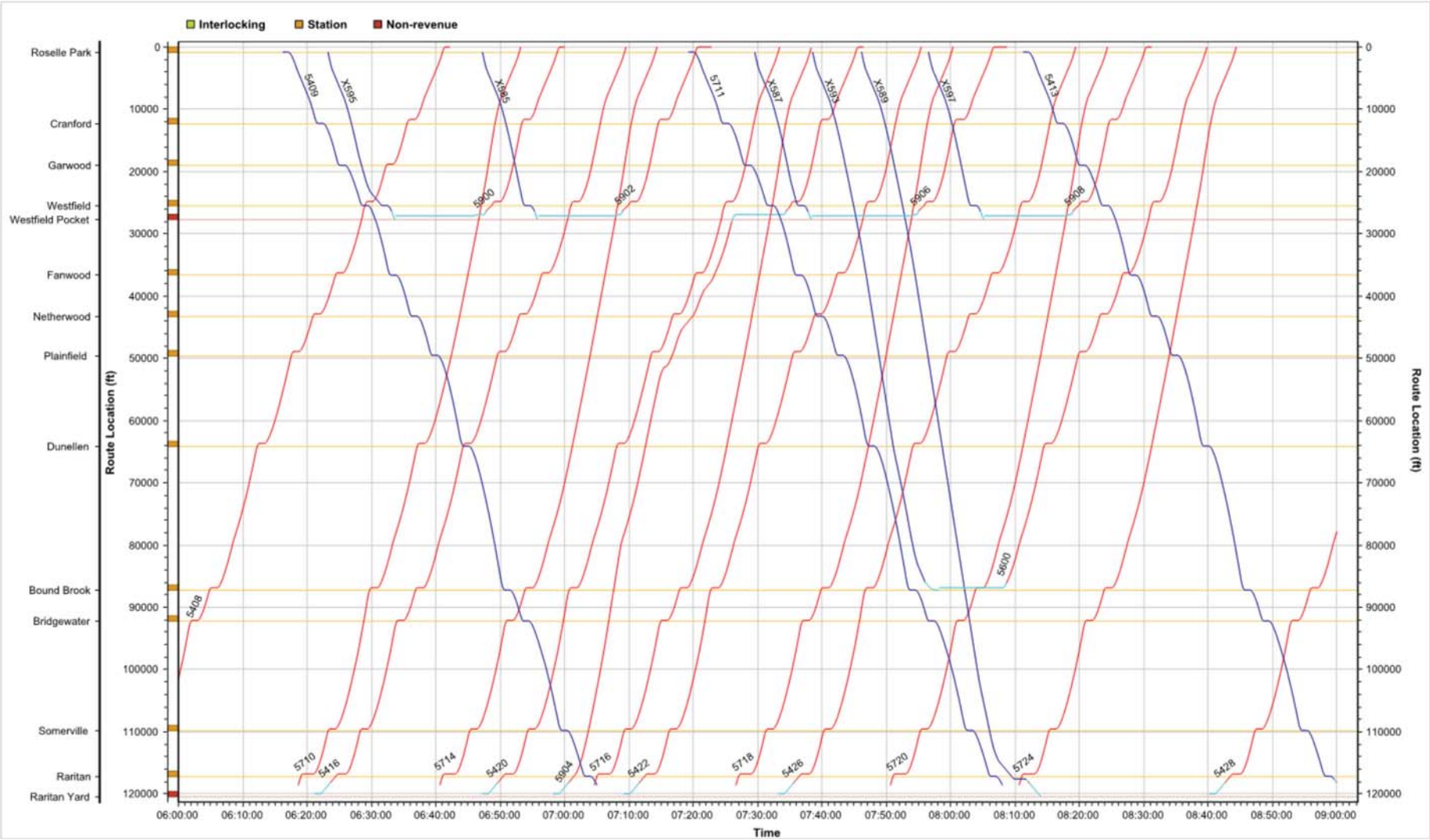


Figure 12 – Scenario 4 AM Time-Distance "String Chart"

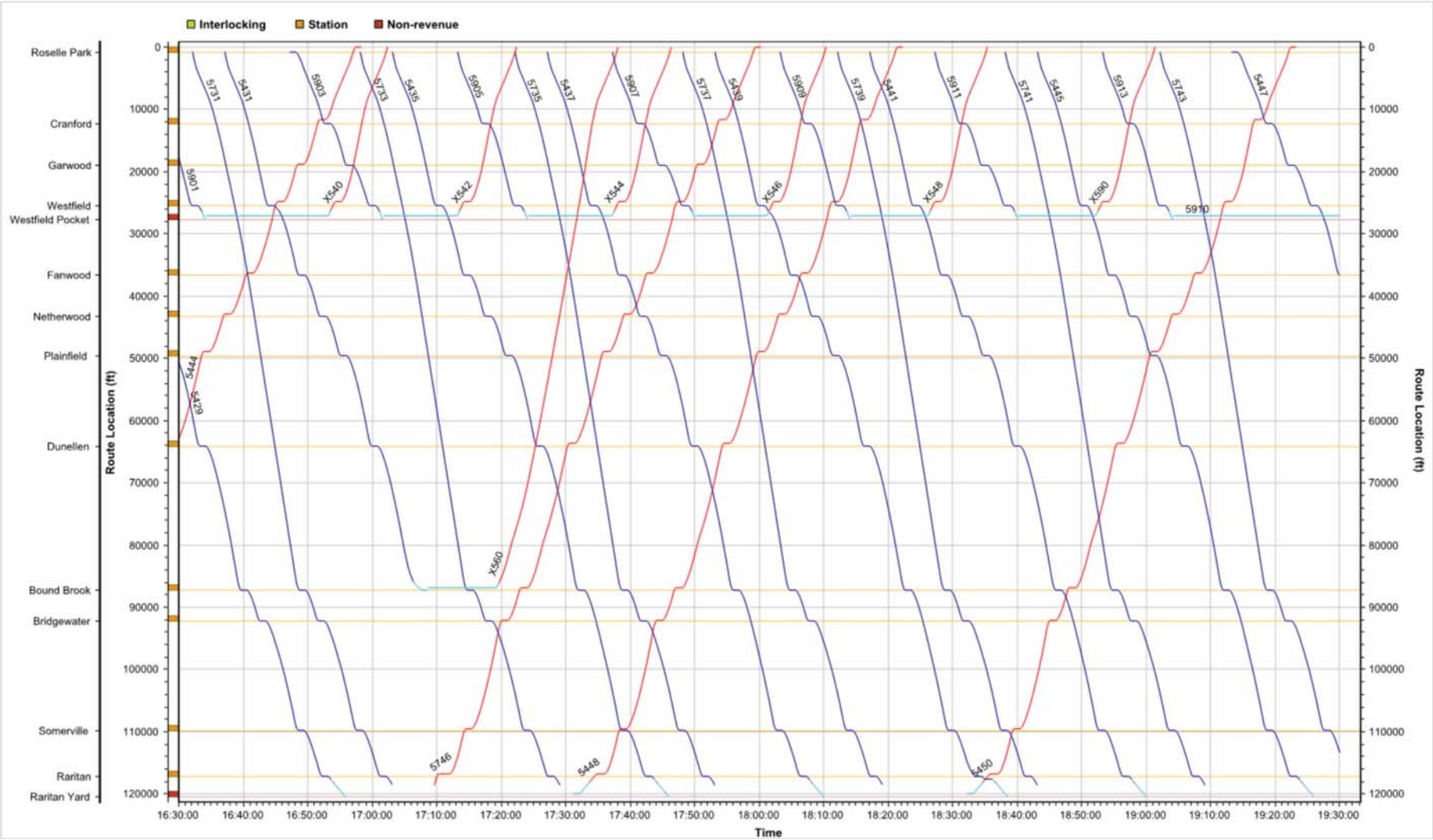


Figure 13 – Scenario 4 PM Time-Distance "String Chart"

Appendix N. Capital Cost Estimate Detail by Scenario

Table 41 – Conceptual Opinion of Probable Cost – Scenario 1

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
10 GUIDEWAY & TRACK ELEMENTS				
10.04	Guideway: Aerial structure. Aldene Bridge	$0	10.0%	$0
10.08	Guideway: Retained cut or fill	$0	5.0%	$0
10.11	Track: Ballasted	$0	5.0%	$0
10.12	Track: Special (switches, turnouts)	$0	5.0%	$0
10.12	No. 10 Equilateral Switch Machine Layout, Heaters	$0	5.0%	$0
10.12	No. 20 Switch Machine Layout, Heaters	$0	5.0%	$0
10.12	No. 32.7 Switch Machine Layout, Heaters	$0	5.0%	$0
	SUBTOTAL SECTION 10	**$0**	**5.0%**	**$0**
20 STATIONS, STOPS, TERMINALS, INTERMODAL				
20.01	Platform	$0	5.0%	$0
20.02	Station Utilities	$0	5.0%	$0
20.07	Elevators, escalators, overpass	$0	5.0%	$0
	SUBTOTAL SECTION 20	**$0**	**5.0%**	**$0**
40 SITEWORK & SPECIAL CONDITIONS				
40.01	Demolition, Track	$0	5.0%	$0
40.04	Temporary Facilities and other indirect costs during construction	$0	5.0%	$0
	SUBTOTAL SECTION 40	**$0**	**5.0%**	**$0**
50 SYSTEMS				
50.01	Interlocking - Pre-Wired Bungalow, Signals	$0	5.0%	$0
50.01	Cab Signal Cut Section - Pre-Wired House, 2-Tracks	$18,980,000	5.0%	$19,929,000
50.01	Cab Signal Cut Section - Pre-Wired House, 3-Tracks	$0	5.0%	$0
50.01	ROCC & BOS Modifications	$0	5.0%	$0
50.01	Removal of Existing Signals, Cases, Cables	$420,000	5.0%	$441,000
	SUBTOTAL SECTION 50	**$19,400,000**	**5.0%**	**$20,370,000**
	CONSTRUCTION SUBTOTAL	**$19,400,000**	**5.0%**	**$20,370,000**
60 ROW, LAND, EXISTING IMPROVEMENTS				
60.01	Purchase or lease of real estate	$0	5.0%	$0
	SUBTOTAL SECTION 60	**$0**	**5.0%**	**$0**

Table 41 – Conceptual Opinion of Probable Cost – Scenario 1

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
80 PROFESSIONAL SERVICES				
80.01	Preliminary Engineering (4%)		4.0%	$814,800
80.02	Final Design (6%)		6.0%	$1,222,200
80.03	Railroad Project Management for Design and Construction (2%)		2.0%	$407,400
80.04	Construction Administration & Management (8.5%)		8.5%	$1,731,450
80.05	Professional Liability and other Non-Construction Insurance (5%)		5.0%	$1,018,500
80.06	Legal; Permits; Review Fees by other agencies, cities, etc. (1%)		1.0%	$203,700
	SUBTOTAL SECTION 80			**$5,398,050**
90 UNALLOCATED CONTINGENCY (40% of Constr.)			**40.0%**	**$8,148,000**
100 FINANCE CHARGES (2% of Construction)			**2.0%**	**$407,400**
	TOTAL PROJECT COST			**$34,323,450**

Table 42 – Conceptual Opinion of Probable Cost – Scenario 2

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
10 GUIDEWAY & TRACK ELEMENTS				
10.04	Guideway: Aerial structure. Aldene Bridge	$0	10.0%	$0
10.04	Guideway: Aerial structure. Leland Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Berkman Street.	$3,400,000	10.0%	$3,740,000
10.08	Guideway: Retained cut or fill	$15,000,000	5.0%	$15,750,000
10.11	Track: Ballasted	$6,167,000	5.0%	$6,475,350
10.12	Track: Special (switches, turnouts)	$4,900,000	5.0%	$5,145,000
10.12	No. 10 Equilateral Switch Machine Layout, Heaters	$94,000	5.0%	$98,700
10.12	No. 20 Switch Machine Layout, Heaters	$0	5.0%	$0
10.12	No. 32.7 Switch Machine Layout, Heaters	$564,000	5.0%	$592,200
	SUBTOTAL SECTION 10	**$30,125,000**	**5.0%**	**$31,631,250**

Table 42 – Conceptual Opinion of Probable Cost – Scenario 2

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
20 STATIONS, STOPS, TERMINALS, INTERMODAL				
	NETHERWOOD STATION			
20.01	400'x12' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$4,800,000	5.0%	$5,040,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators	$1,400,000	5.0%	$1,470,000
	FANWOOD STATION			
20.01	400'x12' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$4,800,000	5.0%	$5,040,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators, overpass	$2,360,000	5.0%	$2,478,000
	SUBTOTAL SECTION 20	**$13,460,000**	**5.0%**	**$14,133,000**
40 SITEWORK & SPECIAL CONDITIONS				
40.01	Demolition, Track	$42,600	5.0%	$44,730
40.02	Demolition, Netherwood	$160,000	5.0%	$168,000
40.03	Demolition, Fanwood	$176,000	5.0%	$184,800
40.08	Temporary Facilities and other indirect costs during construction	$100,000	5.0%	$105,000
	SUBTOTAL SECTION 40	$478,600	5.0%	$502,530
50 SYSTEMS				
50.01	Interlocking - Pre-Wired Bungalow, Signals	$3,134,000	5.0%	$3,290,700
50.01	Cab Signal Cut Section - Pre-Wired House, 2-Tracks	$15,860,000	5.0%	$16,653,000
50.01	Cab Signal Cut Section - Pre-Wired House, 3-Tracks	$3,676,800	5.0%	$3,860,640
50.01	ROCC & BOS Modifications	$50,000	5.0%	$52,500
50.01	Removal of Existing Signals, Cases, Cables	$420,000	5.0%	$441,000
	SUBTOTAL SECTION 50	**$23,140,800**	**5.0%**	**$24,297,840**
	CONSTRUCTION SUBTOTAL	**$67,204,400**	**5.0%**	**$70,564,620**
60 ROW, LAND, EXISTING IMPROVEMENTS				
60.01	Purchase or lease of real estate	$0	5.0%	$0
	SUBTOTAL SECTION 60	**$0**	**5.0%**	**$0**

Table 42 – Conceptual Opinion of Probable Cost – Scenario 2

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
80 PROFESSIONAL SERVICES				
80.01	Preliminary Engineering (4%)			$2,822,585
80.02	Final Design (6%)			$4,233,877
80.03	Railroad Project Management for Design and Construction (2%)			$1,411,292
80.04	Construction Administration & Management (8.5%)			$5,997,993
80.05	Professional Liability and other Non-Construction Insurance (5%)			$3,528,231
80.06	Legal; Permits; Review Fees by other agencies, cities, etc. (1%)			$705,646
	SUBTOTAL SECTION 80			**$18,699,624**
90 UNALLOCATED CONTINGENCY (40% of Constr.)			**40.0%**	**$28,225,848**
100 FINANCE CHARGES (2% of Construction)			**2.0%**	**$1,411,292**
	TOTAL PROJECT COST			**$118,901,385**

Table 43 – Conceptual Opinion of Probable Cost – Scenario 3

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
10 GUIDEWAY & TRACK ELEMENTS				
10.04	Guideway: Aerial structure. Aldene Bridge	$0	10.0%	$0
10.04	Guideway: Aerial structure. Leland Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Berkman Street.	$3,400,000	10.0%	$3,740,000
10.04	Guideway: Aerial structure. Richmond Street.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Roosevelt Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Watchung Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Park Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Madison Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Central Avenue.	$0	10.0%	$0
10.04	Guideway: Aerial structure. New Street.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Liberty Street.	$0	10.0%	$0
10.04	Guideway: Aerial structure. Plainfield Avenue.	$250,000	10.0%	$275,000
10.08	Guideway: Retained cut or fill	$15,000,000	5.0%	$15,750,000
10.11	Track: Ballasted	$10,965,500	5.0%	$11,513,775
10.12	Track: Special (switches, turnouts)	$8,900,000	5.0%	$9,345,000
10.12	No. 10 Equilateral Switch Machine Layout, Heaters	$94,000	5.0%	$98,700
10.12	No. 20 Switch Machine Layout, Heaters	$376,000	5.0%	$394,800
10.12	No. 32.7 Switch Machine Layout, Heaters	$564,000	5.0%	$592,200
	SUBTOTAL SECTION 10	**$39,549,500**	**5.0%**	**$41,526,975**
20 STATIONS, STOPS, TERMINALS, INTERMODAL				
	NETHERWOOD STATION			
20.01	400'x12' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$4,800,000	5.0%	$5,040,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators	$1,400,000	5.0%	$1,470,000
	FANWOOD STATION			
20.01	400'x12' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$4,800,000	5.0%	$5,040,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators, overpass	$2,360,000	5.0%	$2,478,000
	PLAINFIELD STATION			
20.01	630'x12' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$3,780,000	5.0%	$3,969,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators	$1,400,000	5.0%	$1,470,000
	SUBTOTAL SECTION 20	**$18,690,000**	**5.0%**	**$19,624,500**

Table 43 – Conceptual Opinion of Probable Cost – Scenario 3

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
40 SITEWORK & SPECIAL CONDITIONS				
40.01	Demolition, Track	$140,800	5.0%	$147,840
40.02	Demolition, Netherwood	$160,000	5.0%	$168,000
40.03	Demolition, Fanwood	$176,000	5.0%	$184,800
40.03	Demolition, Plainfield	$171,200	5.0%	$179,760
40.08	Temporary Facilities and other indirect costs during construction	$150,000	5.0%	$157,500
	SUBTOTAL SECTION 40	**$798,000**	**5.0%**	**$837,900**
50 SYSTEMS				
50.01	Interlocking - Pre-Wired Bungalow, Signals	$4,701,000	5.0%	$4,936,050
50.01	Cab Signal Cut Section - Pre-Wired House, 2-Tracks	$14,560,000	5.0%	$15,288,000
50.01	Cab Signal Cut Section - Pre-Wired House, 3-Tracks	$5,208,800	5.0%	$5,469,240
50.01	ROCC & BOS Modifications	$50,000	5.0%	$52,500
50.01	Removal of Existing Signals, Cases, Cables	$420,000	5.0%	$441,000
	SUBTOTAL SECTION 50	**$24,939,800**	**5.0%**	**$26,186,790**
	CONSTRUCTION SUBTOTAL	**$83,977,300**	**5.0%**	**$88,176,165**
60 ROW, LAND, EXISTING IMPROVEMENTS				
60.01	Purchase or lease of real estate	$0	5.0%	$0
	SUBTOTAL SECTION 60	**$0**	**5.0%**	**$0**
80 PROFESSIONAL SERVICES				
80.01	Preliminary Engineering (4%)		4.0%	$3,527,047
80.02	Final Design (6%)		6.0%	$5,290,570
80.03	Railroad Project Management for Design and Construction (2%)		2.0%	$1,763,523
80.04	Construction Administration & Management (8.5%)		8.5%	$7,494,974
80.05	Professional Liability and other Non-Construction Insurance (5%)		5.0%	$4,408,808
80.06	Legal; Permits; Review Fees by other agencies, cities, etc. (1%)		1.0%	$881,762
	SUBTOTAL SECTION 80			**$23,366,684**
90 UNALLOCATED CONTINGENCY (40% of Constr.)			**40.0%**	**$35,270,466**
100 FINANCE CHARGES (2% of Construction)			**2.0%**	**$1,763,523**
	TOTAL PROJECT COST			**$148,576,838**

Table 44 – Conceptual Opinion of Probable Cost – Scenario 4

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
10 GUIDEWAY & TRACK ELEMENTS				
10.04	Guideway: Aerial structure. Aldene Bridge	$0	10.0%	$0
10.04	Guideway: Aerial structure. Main Street.	$0	10.0%	$0
10.08	Guideway: Retained cut or fill	$0	5.0%	$0
10.11	Track: Ballasted	$4,994,500	5.0%	$5,244,225
10.12	Track: Special (switches, turnouts)	$3,800,000	5.0%	$3,990,000
10.12	No. 10 Equilateral Switch Machine Layout, Heaters	$94,000	5.0%	$98,700
10.12	No. 20 Switch Machine Layout, Heaters	$188,000	5.0%	$197,400
10.12	No. 32.7 Switch Machine Layout, Heaters	$0	5.0%	$0
	SUBTOTAL SECTION 10	**$9,076,500**	**5.0%**	**$9,530,325**
20 STATIONS, STOPS, TERMINALS, INTERMODAL				
	BOUND BROOK STATION			
20.01	400'x24' Platform. Platform costs includes: Hi-level platform, canopy, signage, windscreens, benches, lighting and passenger information systems.	$7,200,000	5.0%	$7,560,000
20.02	Station Utilities	$50,000	5.0%	$52,500
20.07	Elevators, escalators, overpass	$2,360,000		$2,360,000
	SUBTOTAL SECTION 20	**$9,610,000**	**5.0%**	**$10,090,500**
40 SITEWORK & SPECIAL CONDITIONS				
40.01	Demolition, Track	$249,800	5.0%	$262,290
40.02	Demolition, Bound Brook	$160,000	5.0%	$168,000
40.08	Temporary Facilities and other indirect costs during construction	$50,000	5.0%	$52,500
	SUBTOTAL SECTION 40	**$459,800**	**5.0%**	**$482,790**
50 SYSTEMS				
50.01	Interlocking - Pre-Wired Bungalow, Signals	$3,134,000	5.0%	$3,290,700
50.01	Cab Signal Cut Section - Pre-Wired House, 2-Tracks	$16,640,000	5.0%	$17,472,000
50.01	Cab Signal Cut Section - Pre-Wired House, 3-Tracks	$612,800	5.0%	$643,440
50.01	ROCC & BOS Modifications	$50,000	5.0%	$52,500
50.01	Removal of Existing Signals, Cases, Cables	$420,000	5.0%	$441,000
	SUBTOTAL SECTION 50	**$20,856,800**	**5.0%**	**$21,899,640**
	CONSTRUCTION SUBTOTAL	**$40,003,100**	**5.0%**	**$42,003,255**
60 ROW, LAND, EXISTING IMPROVEMENTS				
60.01	Purchase or lease of real estate	$0	5.0%	$0
	SUBTOTAL SECTION 60	**$0**	**5.0%**	**$0**

Table 44 – Conceptual Opinion of Probable Cost – Scenario 4

Cost Categories	Description	Base Cost	Allocated Contingency	Total Cost
80 PROFESSIONAL SERVICES				
80.01	Preliminary Engineering (4%)			$1,680,130
80.02	Final Design (6%)			$2,520,195
80.03	Railroad Project Management for Design and Construction (2%)			$840,065
80.04	Construction Administration & Management (8.5%)			$3,570,277
80.05	Professional Liability and other Non-Construction Insurance (5%)			$2,100,163
80.06	Legal; Permits; Review Fees by other agencies, cities, etc. (1%)			$420,033
	SUBTOTAL SECTION 80			**$11,130,863**
90 UNALLOCATED CONTINGENCY (40% of Constr.)			**40.0%**	**$16,801,302**
100 FINANCE CHARGES (2% of Construction)			**2.0%**	**$840,065**
	TOTAL PROJECT COST			**$70,775,485**

Table 45 – Conceptual Opinion of Probable Cost - C&S Estimate Detail Breakdown

ITEM MATERIAL	QTY	UNIT	COST	2-Trk CS 8x10	QTY	UNIT	COST	3-Trk CS 8x12	QTY	UNIT	COST	Intrlkg. 8x20
Bungalow												
Bungalow Housing, aluminum, complete*	1	EA	$ 31,300	$ 31,300	1	EA	$ 34,000	$ 34,000	1	EA	$ 60,000	$ 60,000
Housing Foundations	6	EA	$ 500	$ 3,000	8	EA	$ 500	$ 4,000	12	EA	$ 500	$ 6,000
Track Circuits & Trk/CS Interfaces	1	EA	$ 22,600	$ 22,600	1	EA	$ 22,600	$ 22,600	2	EA	$ 22,600	$ 45,200
Vital/Non-Vital Processor(s)		EA	$ 40,000	$ -		EA	$ 40,000	$ -	2	EA	$ 40,000	$ 80,000
Racks - Relay, Electronics, Entrance	3	EA	$ 800	$ 2,400	4	EA	$ 800	$ 3,200	8	EA	$ 800	$ 6,400
Relays - Vital	8	EA	$ 1,200	$ 9,600	12	EA	$ 1,200	$ 14,400	24	EA	$ 1,200	$ 28,800
Relays - Non-Vital	5	EA	$ 300	$ 1,500	6	EA	$ 300	$ 1,800	20	EA	$ 300	$ 6,000
Transformers	1	EA	$ 1,200	$ 1,200	1	EA	$ 1,200	$ 1,200	4	EA	$ 1,200	$ 4,800
Rectifiers, Chargers	1	EA	$ 1,300	$ 1,300	1	EA	$ 1,300	$ 1,300	5	EA	$ 1,300	$ 6,500
Batteries, UPS	6	EA	$ 350	$ 2,100	6	EA	$ 350	$ 2,100	45	EA	$ 350	$ 15,750
Wire, terminals, tags, ties, etc.	1	LS	$ 11,000	$ 11,000	1	LS	$ 11,000	$ 11,000	2	LS	$ 11,000	$ 22,000
Local Control Panel		EA	$ 3,500	$ -		EA	$ 3,500	$ -	1	EA	$ 3,500	$ 3,500
Event Recorder		EA	$ 4,000	$ -		EA	$ 4,000	$ -	1	EA	$ 4,000	$ 4,000
Fire/Intrusion Alarms	1	EA	$ 2,000	$ 2,000	1	EA	$ 2,000	$ 2,000	2	EA	$ 2,000	$ 4,000
Phone, Modem, F.O. Panel	1	LS										
Fence & Gates	60	LF	$ 75	$ 4,500	64	LF	$ 75	$ 4,800	80	LF	$ 75	$ 6,000
Ground Rods, Wire, Grid	1	LS	$ 1,500	$ 1,500	1	LS	$ 1,500	$ 1,500	2	LS	$ 1,500	$ 3,000
Power Panel/Load Center	1	EA	$ 300	$ 300	1	EA	$ 300	$ 300	1	EA	$ 300	$ 300
PTC/RF Interface Packages		EA	$ 13,000	$ -		EA	$ 13,000	$ -	1	EA	$ 13,000	$ 13,000
FRA/Maintainers Test Panel		EA	$ 1,500	$ -		EA	$ 1,500	$ -	1	EA	$ 1,500	$ 1,500
Utility Pole, AC Service Drop	1	EA	$ 5,000	$ 5,000	1	EA	$ 5,000	$ 5,000	1	EA	$ 5,000	$ 5,000
RF, GPS, PTC Antennas & Tower		EA	$ 12,000	$ -		EA	$ 12,000	$ -	1	EA	$ 12,000	$ 12,000
Surge/Lightning Arrestors, Resistors	1	LS	$ 1,000	$ 1,000	1	LS	$ 1,500	$ 1,500	1	LS	$ 2,700	$ 2,700
Bootlegs/Risers, JBs, Conduit, Trough	1	LS	$ 10,000	$ 10,000	1	LS	$ 12,000	$ 12,000	1	LS	$ 30,000	$ 30,000
HVAC - Heaters &/or Fans	1	LS	$ 1,200	$ 1,200	1	LS	$ 1,200	$ 1,200	1	LS	$ 4,000	$ 4,000
Misc. Materials & Consumables** (5%)	1	LS	$ 5,515	$ 5,515	1	LS	$ 6,135	$ 6,135	1	LS	$ 18,323	$ 18,323
TOTAL				$ 117,015				$ 130,035				$ 388,773

* Bungalow Housing, aluminum, complete - $/SF - 8x10 - $ 391, 8x12 - $ 354, 8x20 - $ 375

**Misc. includes locks, signs, electrical tape, duct seal/packing, caulk, paint, brushes, grease, solvents, cement, cleaning material, small hardware, hand tools, test & adjustment tools, staging material, step stools, work lights, portable fans, heaters, light bulbs/tubes, fuses, disposable PPEs.

Table 45 – Conceptual Opinion of Probable Cost - C&S Estimate Detail Breakdown

ITEM MATERIAL	QTY	UNIT	COST	2-Trk CS 8x10	QTY	UNIT	COST	3-Trk CS 8x12	QTY	UNIT	COST	Intrlkg. 8x20
External Cables, Bonds												
Cable - Power	300	LF	$ 6.35	$ 1,905	300	LF	$ 6.35	$ 1,905	1400	LF	$ 6.35	$ 8,890
Cable - Track	500	LF	$ 1.70	$ 850	1000	LF	$ 1.70	$ 1,700	6000	LF	$ 1.70	$ 10,200
Cable - Signal		LF	$ 5.00	$ -		LF	$ 5.00	$ -	4600	LF	$ 5.00	$ 23,000
Cable - Switch		LF	$ 1.80	$ -		LF	$ 1.80	$ -	2000	LF	$ 1.80	$ 3,600
Cable - Express Line (3.5 mi.)	1700	LF	$ 4.75	$ 8,075	1700	LF	$ 4.75	$ 8,075	18500	LF	$ 4.75	$ 87,875
Cable - Code/Data, Comm. (3.5 mi.)	1700	LF	$ 5.50	$ 9,350	1700	LF	$ 5.50	$ 9,350	18500	LF	$ 5.50	$ 101,750
Cable - Snow Melter		LF	$ 3.50	$ -		LF	$ 3.50	$ -	1500	LF	$ 3.50	$ 5,250
Track Bonds	100	EA	$ 6.00	$ 600	150	EA	$ 6.00	$ 900	150	EA	$ 6.00	$ 900
Impedance Bonds		EA	$ 2,500	$ -		EA	$ 2,500	$ -	10	EA	$ 2,500	$ 25,000
Cable - 4/0 or 500 MCM Power		LF	$ 13.75	$ -		LF	$ 13.75	$ -	1400	LF	$ 13.75	$ 19,250
TOTAL				$ 20,780				$ 21,930				$ 285,715
Power Switch & Lock Layout - Electric												
Switch & Lock Machine Layout Complete									1	LS	$ 26,000	$ 26,000
Rail & Crib Heater Elements, JBs, Shields									1	LS	$ 16,000	$ 16,000
Switch Bonding									1	LS	$ 5,000	$ 5,000
TOTAL												47,000
Snow Melter Control Panel, Assembly									1	LS	$ 13,200	$ 13,200
Wayside Home Signal Location - 2 Tracks												
High CL Signal, 3-Heads									2	EA	$ 4,500	$ 9,000
Cantilever Mast, Ladder, JB, Brackets									1	EA	$ 16,000	$ 16,000
Cantilever Foundation									1	EA	$ 8,000	$ 8,000
TOTAL												33,000
Wayside Home Signal Location - 3 Tracks												
High CL Signal, 3-Heads									3	EA	$ 4,500	$ 13,500
Signal Bridge, Ladder, JBs, Brackets									1	EA	$ 40,000	$ 40,000
Signal Bridge Foundation									2	EA	$ 15,000	$ 30,000
TOTAL												83,500
Labor (NJT In-House)												
Signal Gang (6-man; Factored 8-hr ST)	15	GD	$ 3,840	$ 57,600	20	GD	$ 3,840	$ 76,800	100	GD	$ 3,840	$ 384,000
Comm. Gang (3-man; Factored 8-hr ST)	5	GD	$ 1,920	$ 9,600	5	GD	$ 1,920	$ 9,600	20	GD	$ 1,920	$ 38,400
Engineering/Supervision	80	MD	$ 680	$ 54,400	100	MD	$ 680	$ 68,000	500	MD	$ 680	$ 340,000
TOTAL				$ 121,600				$ 154,400				762,400
TOTAL								**$ 306,365**				**$ 1,566,588**

Table 46 – Order of Magnitude Cost Estimate - Signals Only (2012 Dollars)

Work Element	Work Element Description	Unit	Proposed Unit Cost - Labor & Material*	Scenario 1 High Capacity Signal System Only		Scenario 2 High Capacity Signal System & Netherwood to Fanwood Third Trk		Scenario 3 High Capacity Signal System & Plainfield to Fanwood Third Trk		Scenario 4 High Capacity Signal System & Bound Brook & Westfield Turnbacks	
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
50.01	Interlocking - Pre-Wired Bungalow, Signals	EA	$ 1,567,000		$ 0	2	$ 3,134,000	3	$ 4,701,000	2	$ 3,134,000
50.01	Cab Signal Cut Section - Pre-Wired House, 2-Tracks	EA	$ 260,000	73	$ 18,980,000	61	$ 15,860,000	56	$ 14,560,000	64	$ 16,640,000
50.01	Cab Signal Cut Section - Pre-Wired House, 3-Tracks	EA	$ 306,400		$ 0	12	$ 3,676,800	17	$ 5,208,800	2	$ 612,800
50.01	ROCC & BOS Modifications	LS	$ 50,000		$ 0	1	$ 50,000	1	$ 50,000	1	$ 50,000
50.01	Removal of Existing Signals, Cases, Cables	EA	$ 20,000	21	$ 420,000	21	$ 420,000	21	$ 420,000	21	$ 420,000
10.12	No. 10 Equilateral Switch Machine Layout, Heaters	EA	$ 47,000		$ 0	2	$ 94,000	2	$ 94,000	2	$ 94,000
10.12	No. 20 Switch Machine Layout, Heaters	EA	$ 47,000		$ 0		$ 0	8	$ 376,000	4	$ 188,000
10.12	No. 32.7 Switch Machine Layout, Heaters	EA	$ 47,000		$ 0	12	$ 564,000	12	$ 564,000		$ 0
	SUBTOTALS				$ 19,400,000		$ 23,798,800		$ 25,973,800		$ 21,138,800

*Note: Does not include: any track, civil, or structural work; equipment costs; project/construction management; material handling, shipping, storage; escalation, contingency, or general conditions, etc.

Table 47 – Raritan Valley Line – Track – Civil – Scenario 1

Sheet #	TK-40	TK-41										QUANTITY	UNIT COST	TOTAL COST
MP	15.4-15.1	15.1-Lehigh												
NEW TRACK (TF)												0	$350	$0
New #10 T.O (EA)												0	$300,000	$0
New #20 T.O (EA)												0	$500,000	$0
New # 20 X.O. (EA)												0	$1,000,000	$0
New #10 EQU (EA)												0	$250,000	$0
New #15 T.O (EA)												0	$350,000	$0
New # 15 X.O. (EA)												0	$700,000	$0
New #32.75 T.O (EA)												0	$700,000	$0
New # 32.75 X.O. (EA)												0	$1,400,000	$0
Remove Exist. Track (TF)												0	$20	$0
New Bridge (LF)												0	$10,000	$0
Hi Walls and Emb (LF)												0	$10,000	$0
Low Walls and Emb (LF)												0	$5,000	$0
														$0

Table 48 – Raritan Valley Line – Track – Civil – Scenario 2

Sheet #	TK-27	TK-28	TK-29	TK-30	TK-31	TK-32	TK-40	TK-41				QUANTITY	UNIT COST	TOTAL COST
MP	22.7-22.2	22.2-21.6	21.6-21.0	21.0-20.4	20.4-19.8	19.8-19.4	15.4-15.1	15.1-Lehigh						
NEW TRACK (TF)	3,260	3,000	3,000	3,000	2,800	2,560						**17,620**	$350	$6,167,000
New #10 T.O (EA)												**0**	$300,000	$0
New #20 T.O (EA)												**0**	$500,000	$0
New # 20 X.O. (EA)												**0**	$1,000,000	$0
New #10 EQU (EA)												**0**	$250,000	$0
New #15 T.O (EA)												**0**	$350,000	$0
New # 15 X.O. (EA)												**0**	$700,000	$0
New #32.75 T.O (EA)	1											**1**	$700,000	$700,000
New # 32.75 X.O. (EA)	1					2						**3**	$1,400,000	$4,200,000
Remove Exist. Track (TF)	1,230					900						**2,130**	$20	$42,600
New Bridge (LF)												**0**	$10,000	$0
Hi Walls and Emb (LF)		1,500										**1,500**	$10,000	$15,000,000
Low Walls and Emb (LF)			600									**600**	$5,000	$3,000,000
														$29,109,600

Table 49 – Raritan Valley Line – Track – Civil – Scenario 3

Sheet #	TK-24	TK-25	TK-26	TK-27	TK-28	TK-29	TK-30	TK-31	TK-32	TK-40	TK-41	QUANTITY	UNIT COST	TOTAL COST
MP	24.5-23.9	23.9-23.2	23.2-22.7	22.7-22.2	22.2-21.6	21.6-21.0	21.0-20.4	20.4-19.8	19.8-19.4	15.4-15.1	15.1-Lehigh			
NEW TRACK (TF)	2,860	6,430	4,030	3,650	3,000	3,000	3,000	2,800	2,560			**31,330**	$350	$10,965,500
New #10 T.O (EA)												**0**	$300,000	$0
New #20 T.O (EA)												**0**	$500,000	$0
New # 20 X.O. (EA)			3	1								**4**	$1,000,000	$4,000,000
New #10 EQU (EA)												**0**	$250,000	$0
New #15 T.O (EA)												**0**	$350,000	$0
New # 15 X.O. (EA)												**0**	$700,000	$0
New #32.75 T.O (EA)	1											**1**	$700,000	$700,000
New # 32.75 X.O. (EA)		1							2			**3**	$1,400,000	$4,200,000
Remove Exist. Track (TF)	2,160	3,080	600	300					900			**7,040**	$20	$140,800
New Bridge (LF)												**0**	$10,000	$0
Hi Walls and Emb (LF)					1,500							**1,500**	$10,000	$15,000,000
Low Walls and Emb (LF)						600						**600**	$5,000	$3,000,000
														$38,006,300

Table 50 – Raritan Valley Line – Track – Civil – Scenario 4

Sheet #	TK-12	TK-13	TK-14	TK-32	TK-33	TK-34	TK-40	TK-41				QUANTITY	UNIT COST	TOTAL COST
MP	31.2-30.6	30.6-30.0	30.0-29.5	19.8-19.4	19.4-18.8	18.8-18.3	15.4-15.1	15.1-Lehigh						
NEW TRACK (TF)	530	3,800	0	40	8,480	1,420						**14,270**	$350	$4,994,500
New #10 T.O (EA)		2										**2**	$300,000	$600,000
New #20 T.O (EA)					4							**4**	$500,000	$2,000,000
New # 20 X.O. (EA)												**0**	$1,000,000	$0
New #10 EQU (EA)					2							**2**	$250,000	$500,000
New #15 T.O (EA)												**0**	$350,000	$0
New # 15 X.O. (EA)		1										**1**	$700,000	$700,000
New #32.75 T.O (EA)												**0**	$700,000	$0
New # 32.75 X.O. (EA)												**0**	$1,400,000	$0
Remove Exist. Track (TF)	530	4,500		40	6,000	1,420						**12,490**	$20	$249,800
New Bridge (LF)												**0**	$10,000	$0
Hi Walls and Emb (LF)												**0**	$10,000	$0
Low Walls and Emb (LF)					3,250	800						**4,050**	$5,000	$20,250,000
														$29,294,300

Appendix O. Future Operating Plans

Table 51 – Future Operating Plans - Scenario 1 – Eastbound

EASTBOUND	AM														
TRAINS	5404	2406	5408	5710	5412	5416	5714	SPX 02	5718	5420	SPX 04	5422	5902	5426	5730
Departing from:						NEW TIME	NEW TIME	EXPRESS			EXPRESS				
RARITAN	S 4 46	S 5 12	S 5 54	S 6 22	S 6 33	S 6 43	S 6 52	S 7 00	S 7 13	S 7 20	S 7 35	S 7 39		S 8 45	S 9 49
Somerville	S 4 49	S 5 15	S 5 57	S 6 25	S 6 36	S 6 46	S 6 55		S 7 16	S 7 23		S 7 42		S 8 48	S 9 52
Bridgewater	S 4 53	S 5 19	S 6 01		S 6 41	S 6 51			S 7 21	S 7 28		S 7 47		S 8 52	S 9 56
Bound Brook	S 4 56	S 5 22	S 6 04	S 6 31		S 6 54	S 7 01		S 7 24	S 7 31		S 7 50		S 8 55	S 9 59
Dunellen	S 5 01	S 5 28	S 6 10	S 6 37		S 7 00	S 7 07	S 7 12	S 7 30	S 7 37	S 7 47	S 7 56		S 9 02	S 10 06
Plainfield	S 5 06	S 5 32	S 6 15		S 6 51	S 7 05		S 7 17		S 7 42	S 7 52	S 8 01	S 8 28	S 9 06	S 10 11
Netherwood	S 5 09	S 5 35	S 6 18		S 6 54	S 7 08				S 7 45		S 8 04	S 8 30	S 9 09	S 10 14
Fanwood	S 5 12	S 5 38	S 6 21		S 6 58	S 7 12		S 7 22		S 7 48	S 7 57	S 8 08	S 8 32	S 9 12	S 10 17
Westfield	S 5 16	S 5 42	S 6 26	S 6 48			S 7 18	S 7 27	S 7 40	S 7 53	S 8 02	S 8 13	S 8 37	S 9 17	S 10 22
Garwood		S 5 45	S 6 29		S 7 02					S 7 56				S 9 20	
Cranford	S 5 20	S 5 48	S 6 33	S 6 52		S 7 18	S 7 23	S 7 32		S 7 59	S 8 07	S 8 17	S 8 41	S 9 23	S 10 26
Roselle Park	S 5 25	S 5 53	S 6 38		S 7 10	S 7 24				S 8 05		S 8 22	S 8 46	S 9 29	S 10 31
Union	S 5 29	S 5 57	S 6 42		S 7 13	S 7 27				S 8 09		S 8 26	S 8 50	S 9 33	S 10 35
NEWARK PENN STATION	A 5 41	S 6 08	A 6 55	S 7 10	A 7 26	S 7 39	A 7 42	S 7 50	S 8 01	A 8 22	S 8 25	S 8 38	S 9 02	S 9 46	S 10 47

EASTBOUND	AM		PM											
TRAINS	5432	5434	5736	5438	5440	5742	5444	5746	5448	5450	5452	5454	5456	5458
Departing from:														
RARITAN	S 10 49	S 11 49	S 12 48	S 13 49	S 14 49	S 15 37	S 16 10	S 17 10	S 17 34	S 18 35	S 20 04	S 21 50	S 22 50	S 23 40
Somerville	S 10 52	S 11 52	S 12 51	S 13 52	S 14 52	S 15 40	S 16 13	S 17 13	S 17 37	S 18 38	S 20 07	S 21 53	S 22 53	S 23 43
Bridgewater	S 10 56	S 11 56	S 12 55	S 13 56	S 14 56	S 15 45	S 16 18	S 17 17	S 17 42	S 18 43	S 20 11	S 21 57	S 22 57	S 23 47
Bound Brook	S 10 59	S 11 59	S 12 58	S 13 59	S 14 59	S 15 48	S 16 21	S 17 20	S 17 45	S 18 46	S 20 14	S 22 00	S 23 00	S 23 50
Dunellen	S 11 06	S 12 06	S 13 05	S 14 06	S 15 06	S 15 55	S 16 27	S 17 26	S 17 50	S 18 52	S 20 20	S 22 06	S 23 06	S 23 56
Plainfield	S 11 12	S 12 12	S 13 11	S 14 12	S 15 12	S 16 00	S 16 32	S 17 31	S 17 55	S 18 56	S 20 25	S 22 11	S 23 11	S 0 01
Netherwood	S 11 15	S 12 15	S 13 14	S 14 15	S 15 15	S 16 03	S 16 34	S 17 33	S 17 58	S 18 59	S 20 27	S 22 13	S 23 13	S 0 03
Fanwood	S 11 19	S 12 19	S 13 18	S 14 19	S 15 19	S 16 06	S 16 38	S 17 36	S 18 01	S 19 02	S 20 30	S 22 16	S 23 16	S 0 06
Westfield	S 11 25	S 12 25	S 13 23	S 14 25	S 15 25	S 16 10	S 16 42	S 17 41	S 18 06	S 19 07	S 20 35	S 22 21	S 23 21	S 0 11
Garwood			S 13 26			S 16 13	S 16 45	S 17 44						
Cranford	S 11 29	S 12 29	S 13 29	S 14 29	S 15 29	S 16 16	S 16 48	S 17 47	S 18 10	S 19 11	S 20 39	S 22 25	S 23 25	S 0 15
Roselle Park	S 11 34	S 12 34	S 13 34	S 14 34	S 15 34	S 16 22	S 16 53	S 17 53	S 18 16	S 19 16	S 20 44	S 22 30	S 23 30	S 0 20
Union	S 11 38	S 12 38	S 13 38	S 14 38	S 15 38	S 16 25	S 16 57	S 17 57	S 18 19	S 19 20	S 20 48	S 22 34	S 23 34	S 0 24
NEWARK PENN STATION	S 11 50	S 12 50	S 13 50	S 14 50	S 15 50	S 16 40	S 17 09	S 18 06	S 18 33	S 19 35	S 21 01	A 22 47	A 23 47	A 0 38

Table 52 – Future Operating Plans - Scenario 1 – Westbound

WESTBOUND	AM								PM						
TRAINS	5409	5711	X591	5413	5415	5719	5421	5423	5725	5427	5729	5431	5733	SPX 01	5435
Departing from:														EXPRESS	
NEWARK PENN STATION	S 6 06	S 7 09	E 7 55	S 8 00	S 9 07	S 10 07	S 11 07	S 12 07	S 13 07	S 14 07	S 15 08	S 16 12	S 16 45	S 17 04	S 17 18
Union	S 6 14	S 7 17		S 8 09	S 9 15	S 10 15	S 11 15	S 12 15	S 13 15	S 14 15	S 15 16	D 16 20	D 16 54		D 17 26
Roselle Park	S 6 17	S 7 20		S 8 12	S 9 18	S 10 18	S 11 18	S 12 18	S 13 18	S 14 18	S 15 19	D 16 24	D 16 58		D 17 30
Cranford	S 6 22	S 7 25		S 8 17	S 9 23	S 10 23	S 11 23	S 12 23	S 13 23	S 14 23	S 15 24	D 16 28	D 17 03	D 17 15	D 17 35
Garwood	S 6 24	S 7 27		S 8 19		S 10 26				S 14 26	S 15 27	D 16 31	D 17 06		
Westfield	S 6 27	S 7 31		S 8 23	S 9 27	S 10 29	S 11 27	S 12 27	S 13 27	S 14 29	S 15 30	D 16 35	D 17 09	D 17 20	D 17 40
Fanwood	S 6 32	S 7 35		S 8 27	S 9 31	S 10 33	S 11 31	S 12 31	S 13 31	S 14 33	S 15 34	D 16 39	D 17 14	D 17 25	D 17 44
Netherwood	S 6 35	S 7 38		S 8 30	S 9 34	S 10 36	S 11 34	S 12 34	S 13 34	S 14 36	S 15 37	D 16 42	D 17 17		D 17 47
Plainfield	S 6 38	S 7 41	S 8 18	S 8 33	S 9 37	S 10 39	S 11 37	S 12 37	S 13 37	S 14 39	S 15 40	D 16 45	D 17 21	D 17 30	D 17 50
Dunellen	S 6 42	S 7 46		S 8 38	S 9 42	S 10 44	S 11 42	S 12 42	S 13 42	S 14 44	S 15 45	D 16 50	D 17 26	D 17 35	D 17 55
Bound Brook	S 6 48	S 7 51		S 8 44	S 9 49	S 10 51	S 11 49	S 12 49	S 13 48	S 14 51	S 15 51	D 16 56	D 17 32		D 18 01
Bridgewater	S 6 51	S 7 54		D 8 47	D 9 51	D 10 53	D 11 51	D 12 51	S 13 51	D 14 53	S 15 53	D 16 59	D 17 35		D 18 04
Somerville	S 6 56	S 7 59		D 8 52	D 9 56	D 10 58	D 11 56	D 12 56	S 13 56	D 14 58	S 15 58	D 17 04	D 17 40		D 18 09
RARITAN	S 7 00	S 8 02		S 8 59	S 10 03	D 11 01	S 12 03	S 13 03	S 13 59	S 15 05	S 16 01	S 17 11	D 17 43	S 17 48	D 18 15

WESTBOUND	PM													
TRAINS	5737	5439	SPX 03	5441	5743	5445	5447	5749	5451	5753	5455	5757	5401	5403	
Departing from:			EXPRESS												
NEWARK PENN STATION	S 17 38	S 17 48	S 18 04	S 18 05	S 18 24	S 18 31	S 18 52	S 19 25	S 20 13	S 21 09	S 22 09	S 23 09	S 0 29	S 1 29	
Union		D 17 55		D 18 13		D 18 39	S 19 00	S 19 33	S 20 21	S 21 17	S 22 17	S 23 17	S 0 37	S 1 37	
Roselle Park		D 17 59		D 18 17		D 18 43	S 19 04	S 19 37	S 20 24	S 21 21	S 22 20	S 23 20	S 0 40	S 1 40	
Cranford		D 18 04	D 18 15	D 18 22		D 18 48	S 19 09	S 19 41	S 20 29	S 21 25	S 22 25	S 23 25	S 0 45	S 1 45	
Garwood		D 18 06				D 18 50	S 19 11		S 20 31	S 21 28	S 22 28			S 1 47	
Westfield	D 17 53	D 18 10	D 18 20	D 18 27	D 18 40	D 18 54	S 19 15	S 19 45	S 20 35	S 21 31	S 22 31	S 23 29	S 0 48	S 1 50	
Fanwood		D 18 15	D 18 25	D 18 31		D 18 58	S 19 20	S 19 50	S 20 39	S 21 35	S 22 35	S 23 33	S 0 52	S 1 54	
Netherwood		D 18 18		D 18 35		D 19 02	S 19 23	S 19 53	S 20 42	S 21 38	S 22 39	S 23 36	S 0 55	S 1 57	
Plainfield	D 17 59	D 18 21	D 18 30	D 18 38	D 18 46	D 19 05	S 19 26	S 19 56	S 20 45	S 21 41	S 22 42	S 23 39	S 0 58	S 1 59	
Dunellen	D 18 04	D 18 26	D 18 35	D 18 43	D 18 52	D 19 10	S 19 31	S 20 01	S 20 50	S 21 46	S 22 46	S 23 44	S 1 03	S 2 04	
Bound Brook	D 18 10	D 18 32		D 18 49	D 18 58	D 19 16	S 19 36	S 20 06	S 20 55	S 21 52	S 22 52	S 23 50	S 1 08	S 2 09	
Bridgewater	D 18 14	D 18 35		D 18 52	D 19 01	D 19 19	D 19 39	S 20 09	D 20 58	S 21 54	D 22 55	S 23 52	D 1 10	D 2 12	
Somerville	D 18 19	D 18 40		D 18 57	D 19 06	D 19 24	D 19 44	S 20 14	D 21 03	S 21 59	D 23 00	S 23 57	D 1 15	D 2 16	
RARITAN	D 18 22	S 18 46	S 18 48	S 19 04	D 19 09	D 19 31	S 19 51	S 20 17	S 21 10	S 22 02	S 23 07	S 0 00	S 1 22	S 2 23	

Table 53 – Future Operating Plans - Scenario 2 – Eastbound

EASTBOUND AM																
TRAINS	5404	2406	5408	5710	5412	5416	5714	SXE2	5718	5420	SXE4	5422	5902	5426	5730
Departing from:						NEW TIME	MODIFIED	EXPRESS		NEW TIME	EXPRESS				
RARITAN	S 4 46	S 5 12	S 5 54	S 6 22	S 6 33	S 6 40	S 6 53	S 7 03	S 7 13	S 7 19	S 7 32	S 7 39		S 8 45	S 9 49
Somerville	S 4 49	S 5 15	S 5 57	S 6 25	S 6 36	S 6 43	S 6 56		S 7 16	S 7 22		S 7 42		S 8 48	S 9 52
Bridgewater	S 4 53	S 5 19	S 6 01		S 6 41	S 6 48			S 7 21	S 7 27		S 7 47		S 8 52	S 9 56
Bound Brook	S 4 56	S 5 22	S 6 04	S 6 31		S 6 51	S 7 02		S 7 24	S 7 30		S 7 50		S 8 55	S 9 59
Dunellen	S 5 01	S 5 28	S 6 10	S 6 37		S 6 57	S 7 08		S 7 30	S 7 36		S 7 56		S 9 02	S 10 06
Plainfield	S 5 06	S 5 32	S 6 15		S 6 51	S 7 02				S 7 41		S 8 01	S 8 28	S 9 06	S 10 11
Netherwood	S 5 09	S 5 35	S 6 18		S 6 54	S 7 05	S 7 15			S 7 44		S 8 04	S 8 30	S 9 09	S 10 14
Fanwood	S 5 12	S 5 38	S 6 21		S 6 58	S 7 09	S 7 19			S 7 47		S 8 08	S 8 32	S 9 12	S 10 17
Westfield	S 5 16	S 5 42	S 6 26	S 6 48			S 7 25	S 7 21	S 7 40	S 7 52	S 7 50	S 8 13	S 8 37	S 9 17	S 10 22
Garwood		S 5 45	S 6 29		S 7 02					S 7 55				S 9 20	
Cranford	S 5 20	S 5 48	S 6 33	S 6 52		S 7 15	S 7 29			S 7 58		S 8 17	S 8 41	S 9 23	S 10 26
Roselle Park	S 5 25	S 5 53	S 6 38		S 7 10	S 7 21				S 8 04		S 8 22	S 8 46	S 9 29	S 10 31
Union	S 5 29	S 5 57	S 6 42		S 7 13	S 7 24				S 8 08		S 8 26	S 8 50	S 9 33	S 10 35
NEWARK PENN STATION	A 5 41	S 6 08	A 6 55	S 7 10	A 7 26	S 7 36	A 7 48	S 7 42	S 8 01	A 8 21	S 8 11	S 8 38	S 9 02	S 9 46	S 10 47

EASTBOUND AM PM															
TRAINS	5432	5434	5736	5438	5440	5742	5444	5746	5448	5450	5452	5454	5456	5458	
Departing from:															
RARITAN	S 10 49	S 11 49	S 12 48	S 13 49	S 14 49	S 15 37	S 16 10	S 17 10	S 17 34	S 18 35	S 20 04	S 21 50	S 22 50	S 23 40	
Somerville	S 10 52	S 11 52	S 12 51	S 13 52	S 14 52	S 15 40	S 16 13	S 17 13	S 17 37	S 18 38	S 20 07	S 21 53	S 22 53	S 23 43	
Bridgewater	S 10 56	S 11 56	S 12 55	S 13 56	S 14 56	S 15 45	S 16 18	S 17 17	S 17 42	S 18 43	S 20 11	S 21 57	S 22 57	S 23 47	
Bound Brook	S 10 59	S 11 59	S 12 58	S 13 59	S 14 59	S 15 48	S 16 21	S 17 20	S 17 45	S 18 46	S 20 14	S 22 00	S 23 00	S 23 50	
Dunellen	S 11 06	S 12 06	S 13 05	S 14 06	S 15 06	S 15 55	S 16 27	S 17 26	S 17 50	S 18 52	S 20 20	S 22 06	S 23 06	S 23 56	
Plainfield	S 11 12	S 12 12	S 13 11	S 14 12	S 15 12	S 16 00	S 16 32	S 17 31	S 17 55	S 18 56	S 20 25	S 22 11	S 23 11	S 24 01	
Netherwood	S 11 15	S 12 15	S 13 14	S 14 15	S 15 15	S 16 03	S 16 34	S 17 33	S 17 58	S 18 59	S 20 27	S 22 13	S 23 13	S 24 03	
Fanwood	S 11 19	S 12 19	S 13 18	S 14 19	S 15 19	S 16 06	S 16 38	S 17 36	S 18 01	S 19 02	S 20 30	S 22 16	S 23 16	S 24 06	
Westfield	S 11 25	S 12 25	S 13 23	S 14 25	S 15 25	S 16 10	S 16 42	S 17 41	S 18 06	S 19 07	S 20 35	S 22 21	S 23 21	S 24 11	
Garwood			S 13 26			S 16 13	S 16 45	S 17 44							
Cranford	S 11 29	S 12 29	S 13 29	S 14 29	S 15 29	S 16 16	S 16 48	S 17 47	S 18 10	S 19 11	S 20 39	S 22 25	S 23 25	S 24 15	
Roselle Park	S 11 34	S 12 34	S 13 34	S 14 34	S 15 34	S 16 22	S 16 53	S 17 53	S 18 16	S 19 16	S 20 44	S 22 30	S 23 30	S 24 20	
Union	S 11 38	S 12 38	S 13 38	S 14 38	S 15 38	S 16 25	S 16 57	S 17 57	S 18 19	S 19 20	S 20 48	S 22 34	S 23 34	S 24 24	
NEWARK PENN STATION	S 11 50	S 12 50	S 13 50	S 14 50	S 15 50	S 16 40	S 17 09	S 18 06	S 18 33	S 19 35	S 21 01	A 22 47	A 23 47	A 24 38	

Table 54 – Future Operating Plans - Scenario 2 – Westbound

WESTBOUND	AM								PM						
TRAINS	5409	5711	X591	5413	5415	5719	5421	5423	5725	5427	5729	5431	5733	SXW1	5435
Departing from:														EXPRESS	
NEWARK PENN STATION	S 6 06	S 7 09	E 7 55	S 8 00	S 9 07	S 10 07	S 11 07	S 12 07	S 13 07	S 14 07	S 15 08	S 16 12	S 16 45	S 16 59	S 17 18
Union	S 6 14	S 7 17		S 8 09	S 9 15	S 10 15	S 11 15	S 12 15	S 13 15	S 14 15	S 15 16	D 16 20	D 16 54		D 17 26
Roselle Park	S 6 17	S 7 20		S 8 12	S 9 18	S 10 18	S 11 18	S 12 18	S 13 18	S 14 18	S 15 19	D 16 24	D 16 58		D 17 30
Cranford	S 6 22	S 7 25		S 8 17	S 9 23	S 10 23	S 11 23	S 12 23	S 13 23	S 14 23	S 15 24	D 16 28	D 17 03		D 17 35
Garwood	S 6 24	S 7 27		S 8 19		S 10 26				S 14 26	S 15 27	D 16 31	D 17 06		
Westfield	S 6 27	S 7 31		S 8 23	S 9 27	S 10 29	S 11 27	S 12 27	S 13 27	S 14 29	S 15 30	D 16 35	D 17 09	D 17 14	D 17 40
Fanwood	S 6 32	S 7 35		S 8 27	S 9 31	S 10 33	S 11 31	S 12 31	S 13 31	S 14 33	S 15 34	D 16 39	D 17 14		D 17 44
Netherwood	S 6 35	S 7 38		S 8 30	S 9 34	S 10 36	S 11 34	S 12 34	S 13 34	S 14 36	S 15 37	D 16 42	D 17 17		D 17 47
Plainfield	S 6 38	S 7 41	S 8 18	S 8 33	S 9 37	S 10 39	S 11 37	S 12 37	S 13 37	S 14 39	S 15 40	D 16 45	D 17 21		D 17 50
Dunellen	S 6 42	S 7 46		S 8 38	S 9 42	S 10 44	S 11 42	S 12 42	S 13 42	S 14 44	S 15 45	D 16 50	D 17 26		D 17 55
Bound Brook	S 6 48	S 7 51		S 8 44	S 9 49	S 10 51	S 11 49	S 12 49	S 13 48	S 14 51	S 15 51	D 16 56	D 17 32		D 18 01
Bridgewater	S 6 51	S 7 54		D 8 47	D 9 51	D 10 53	D 11 51	D 12 51	S 13 51	D 14 53	S 15 53	D 16 59	D 17 35		D 18 04
Somerville	S 6 56	S 7 59		D 8 52	D 9 56	D 10 58	D 11 56	D 12 56	S 13 56	D 14 58	S 15 58	D 17 04	D 17 40		D 18 09
RARITAN	S 7 00	S 8 02		S 8 59	S 10 03	D 11 01	S 12 03	S 13 03	S 13 59	S 15 05	S 16 01	S 17 11	D 17 43	S 17 31	D 18 15

WESTBOUND	PM														
TRAINS	5737	5439	SXW3	5441	5743	5445	5447	5749	5451	5753	5455	5757	5401	5403	
Departing from:			EXPRESS												
NEWARK PENN STATION	S 17 38	S 17 48	S 18 02	S 18 05	S 18 24	S 18 31	S 18 52	S 19 25	S 20 13	S 21 09	S 22 09	S 23 09	S 0 29	S 1 29	
Union		D 17 55		D 18 13		D 18 39	S 19 00	S 19 33	S 20 21	S 21 17	S 22 17	S 23 17	S 0 37	S 1 37	
Roselle Park		D 17 59		D 18 17		D 18 43	S 19 04	S 19 37	S 20 24	S 21 21	S 22 20	S 23 20	S 0 40	S 1 40	
Cranford		D 18 04		D 18 22		D 18 48	S 19 09	S 19 41	S 20 29	S 21 25	S 22 25	S 23 25	S 0 45	S 1 45	
Garwood		D 18 06				D 18 50	S 19 11		S 20 31	S 21 28	S 22 28			S 1 47	
Westfield	D 17 53	D 18 10	D 18 17	D 18 27	D 18 40	D 18 54	S 19 15	S 19 45	S 20 35	S 21 31	S 22 31	S 23 29	S 0 48	S 1 50	
Fanwood		D 18 15		D 18 31		D 18 58	S 19 20	S 19 50	S 20 39	S 21 35	S 22 35	S 23 33	S 0 52	S 1 54	
Netherwood		D 18 18		D 18 35		D 19 02	S 19 23	S 19 53	S 20 42	S 21 38	S 22 39	S 23 36	S 0 55	S 1 57	
Plainfield	D 17 59	D 18 21		D 18 38	D 18 46	D 19 05	S 19 26	S 19 56	S 20 45	S 21 41	S 22 42	S 23 39	S 0 58	S 1 59	
Dunellen	D 18 04	D 18 26		D 18 43	D 18 52	D 19 10	S 19 31	S 20 01	S 20 50	S 21 46	S 22 46	S 23 44	S 1 03	S 2 04	
Bound Brook	D 18 10	D 18 32		D 18 49	D 18 58	D 19 16	S 19 36	S 20 06	S 20 55	S 21 52	S 22 52	S 23 50	S 1 08	S 2 09	
Bridgewater	D 18 14	D 18 35		D 18 52	D 19 01	D 19 19	D 19 39	S 20 09	D 20 58	S 21 54	D 22 55	S 23 52	D 1 10	D 2 12	
Somerville	D 18 19	D 18 40		D 18 57	D 19 06	D 19 24	D 19 44	S 20 14	D 21 03	S 21 59	D 23 00	S 23 57	D 1 15	D 2 16	
RARITAN	D 18 22	S 18 46	S 18 34	S 19 04	D 19 09	D 19 31	S 19 51	S 20 17	s 21 10	S 22 02	S 23 07	S 0 00	S 1 22	S 2 23	

Table 55 – Future Operating Plans - Scenario 3 – Eastbound

EASTBOUND AM																
TRAINS	5404	2406	5408	5710	5412	5416	5714	SXE2	5718	5420	SXE4	5422	5902	5426	5730
Departing from:						NEW TIME	MODIFIED	EXPRESS		NEW TIME	EXPRESS				
RARITAN	S 4 46	S 5 12	S 5 54	S 6 22	S 6 33	S 6 40	S 6 53	S 7 03	S 7 13	S 7 19	S 7 32	S 7 39		S 8 45	S 9 49
Somerville	S 4 49	S 5 15	S 5 57	S 6 25	S 6 36	S 6 43	S 6 56		S 7 16	S 7 22		S 7 42		S 8 48	S 9 52
Bridgewater	S 4 53	S 5 19	S 6 01		S 6 41	S 6 48			S 7 21	S 7 27		S 7 47		S 8 52	S 9 56
Bound Brook	S 4 56	S 5 22	S 6 04	S 6 31		S 6 51	S 7 02		S 7 24	S 7 30		S 7 50		S 8 55	S 9 59
Dunellen	S 5 01	S 5 28	S 6 10	S 6 37		S 6 57	S 7 08		S 7 30	S 7 36		S 7 56		S 9 02	S 10 06
Plainfield	S 5 06	S 5 32	S 6 15		S 6 51	S 7 02	S 7 13			S 7 41		S 8 01	S 8 28	S 9 06	S 10 11
Netherwood	S 5 09	S 5 35	S 6 18		S 6 54	S 7 05	S 7 16			S 7 44		S 8 04	S 8 30	S 9 09	S 10 14
Fanwood	S 5 12	S 5 38	S 6 21		S 6 58	S 7 09	S 7 20			S 7 47		S 8 08	S 8 32	S 9 12	S 10 17
Westfield	S 5 16	S 5 42	S 6 26	S 6 48			S 7 26	S 7 21	S 7 40	S 7 52	S 7 50	S 8 13	S 8 37	S 9 17	S 10 22
Garwood		S 5 45	S 6 29		S 7 02					S 7 55				S 9 20	
Cranford	S 5 20	S 5 48	S 6 33	S 6 52		S 7 15	S 7 30			S 7 58		S 8 17	S 8 41	S 9 23	S 10 26
Roselle Park	S 5 25	S 5 53	S 6 38		S 7 10	S 7 21				S 8 04		S 8 22	S 8 46	S 9 29	S 10 31
Union	S 5 29	S 5 57	S 6 42		S 7 13	S 7 24				S 8 08		S 8 26	S 8 50	S 9 33	S 10 35
NEWARK PENN STATION	A 5 41	S 6 08	A 6 55	S 7 10	A 7 26	S 7 36	A 7 49	S 7 42	S 8 01	A 8 21	S 8 11	S 8 38	S 9 02	S 9 46	S 10 47

EASTBOUND AM PM															
TRAINS	5432	5434	5736	5438	5440	5742	5444	5746	5448	5450	5452	5454	5456	5458	5432
Departing from:															
RARITAN	S 10 49	S 11 49	S 12 48	S 13 49	S 14 49	S 15 37	S 16 10	S 17 10	S 17 34	S 18 35	S 20 04	S 21 50	S 22 50	S 23 40	S 10 49
Somerville	S 10 52	S 11 52	S 12 51	S 13 52	S 14 52	S 15 40	S 16 13	S 17 13	S 17 37	S 18 38	S 20 07	S 21 53	S 22 53	S 23 43	S 10 52
Bridgewater	S 10 56	S 11 56	S 12 55	S 13 56	S 14 56	S 15 45	S 16 18	S 17 17	S 17 42	S 18 43	S 20 11	S 21 57	S 22 57	S 23 47	S 10 56
Bound Brook	S 10 59	S 11 59	S 12 58	S 13 59	S 14 59	S 15 48	S 16 21	S 17 20	S 17 45	S 18 46	S 20 14	S 22 00	S 23 00	S 23 50	S 10 59
Dunellen	S 11 06	S 12 06	S 13 05	S 14 06	S 15 06	S 15 55	S 16 27	S 17 26	S 17 50	S 18 52	S 20 20	S 22 06	S 23 06	S 23 56	S 11 06
Plainfield	S 11 12	S 12 12	S 13 11	S 14 12	S 15 12	S 16 00	S 16 32	S 17 31	S 17 55	S 18 56	S 20 25	S 22 11	S 23 11	S 24 01	S 11 12
Netherwood	S 11 15	S 12 15	S 13 14	S 14 15	S 15 15	S 16 03	S 16 34	S 17 33	S 17 58	S 18 59	S 20 27	S 22 13	S 23 13	S 24 03	S 11 15
Fanwood	S 11 19	S 12 19	S 13 18	S 14 19	S 15 19	S 16 06	S 16 38	S 17 36	S 18 01	S 19 02	S 20 30	S 22 16	S 23 16	S 24 06	S 11 19
Westfield	S 11 25	S 12 25	S 13 23	S 14 25	S 15 25	S 16 10	S 16 42	S 17 41	S 18 06	S 19 07	S 20 35	S 22 21	S 23 21	S 24 11	S 11 25
Garwood			S 13 26			S 16 13	S 16 45	S 17 44							
Cranford	S 11 29	S 12 29	S 13 29	S 14 29	S 15 29	S 16 16	S 16 48	S 17 47	S 18 10	S 19 11	S 20 39	S 22 25	S 23 25	S 24 15	S 11 29
Roselle Park	S 11 34	S 12 34	S 13 34	S 14 34	S 15 34	S 16 22	S 16 53	S 17 53	S 18 16	S 19 16	S 20 44	S 22 30	S 23 30	S 24 20	S 11 34
Union	S 11 38	S 12 38	S 13 38	S 14 38	S 15 38	S 16 25	S 16 57	S 17 57	S 18 19	S 19 20	S 20 48	S 22 34	S 23 34	S 24 24	S 11 38
NEWARK PENN STATION	S 11 50	S 12 50	S 13 50	S 14 50	S 15 50	S 16 40	S 17 09	S 18 06	S 18 33	S 19 35	S 21 01	A 22 47	A 23 47	A 24 38	S 11 50

Table 56 – Future Operating Plans - Scenario 3 – Westbound

WESTBOUND	AM								PM						
TRAINS	5409	5711	X591	5413	5415	5719	5421	5423	5725	5427	5729	5431	5733	SXW1	5435
Departing from:														EXPRESS	
NEWARK PENN STATION	S 6 06	S 7 09	E 7 55	S 8 00	S 9 07	S 10 07	S 11 07	S 12 07	S 13 07	S 14 07	S 15 08	S 16 12	S 16 45	S 17 00	S 17 18
Union	S 6 14	S 7 17		S 8 09	S 9 15	S 10 15	S 11 15	S 12 15	S 13 15	S 14 15	S 15 16	D 16 20	D 16 54		D 17 26
Roselle Park	S 6 17	S 7 20		S 8 12	S 9 18	S 10 18	S 11 18	S 12 18	S 13 18	S 14 18	S 15 19	D 16 24	D 16 58		D 17 30
Cranford	S 6 22	S 7 25		S 8 17	S 9 23	S 10 23	S 11 23	S 12 23	S 13 23	S 14 23	S 15 24	D 16 28	D 17 03		D 17 35
Garwood	S 6 24	S 7 27		S 8 19		S 10 26				S 14 26	S 15 27	D 16 31	D 17 06		
Westfield	S 6 27	S 7 31		S 8 23	S 9 27	S 10 29	S 11 27	S 12 27	S 13 27	S 14 29	S 15 30	D 16 35	D 17 09	D 17 15	D 17 40
Fanwood	S 6 32	S 7 35		S 8 27	S 9 31	S 10 33	S 11 31	S 12 31	S 13 31	S 14 33	S 15 34	D 16 39	D 17 14		D 17 44
Netherwood	S 6 35	S 7 38		S 8 30	S 9 34	S 10 36	S 11 34	S 12 34	S 13 34	S 14 36	S 15 37	D 16 42	D 17 17		D 17 47
Plainfield	S 6 38	S 7 41	S 8 18	S 8 33	S 9 37	S 10 39	S 11 37	S 12 37	S 13 37	S 14 39	S 15 40	D 16 45	D 17 21		D 17 50
Dunellen	S 6 42	S 7 46		S 8 38	S 9 42	S 10 44	S 11 42	S 12 42	S 13 42	S 14 44	S 15 45	D 16 50	D 17 26		D 17 55
Bound Brook	S 6 48	S 7 51		S 8 44	S 9 49	S 10 51	S 11 49	S 12 49	S 13 48	S 14 51	S 15 51	D 16 56	D 17 32		D 18 01
Bridgewater	S 6 51	S 7 54		D 8 47	D 9 51	D 10 53	D 11 51	D 12 51	S 13 51	D 14 53	S 15 53	D 16 59	D 17 35		D 18 04
Somerville	S 6 56	S 7 59		D 8 52	D 9 56	D 10 58	D 11 56	D 12 56	S 13 56	D 14 58	S 15 58	D 17 04	D 17 40		D 18 09
RARITAN	S 7 00	S 8 02		S 8 59	S 10 03	D 11 01	S 12 03	S 13 03	S 13 59	S 15 05	S 16 01	S 17 11	D 17 43	S 17 32	D 18 15

WESTBOUND	PM													
TRAINS	5737	5439	SXW3	5441	5743	5445	5447	5749	5451	5753	5455	5757	5401	5403	
Departing from:		NEW TIME	EXPRESS												
NEWARK PENN STATION	S 17 38	S 17 48	S 18 02	S 18 05	S 18 24	S 18 31	S 18 52	S 19 25	S 20 13	S 21 09	S 22 09	S 23 09	S 0 29	S 1 29	
Union		D 17 55		D 18 13		D 18 39	S 19 00	S 19 33	S 20 21	S 21 17	S 22 17	S 23 17	S 0 37	S 1 37	
Roselle Park		D 18 01		D 18 17		D 18 43	S 19 04	S 19 37	S 20 24	S 21 21	S 22 20	S 23 20	S 0 40	S 1 40	
Cranford		D 18 06		D 18 22		D 18 48	S 19 09	S 19 41	S 20 29	S 21 25	S 22 25	S 23 25	S 0 45	S 1 45	
Garwood		D 18 08				D 18 50	S 19 11		S 20 31	S 21 28	S 22 28			S 1 47	
Westfield	D 17 53	D 18 12	D 18 17	D 18 27	D 18 40	D 18 54	S 19 15	S 19 45	S 20 35	S 21 31	S 22 31	S 23 29	S 0 48	S 1 50	
Fanwood		D 18 17		D 18 31		D 18 58	S 19 20	S 19 50	S 20 39	S 21 35	S 22 35	S 23 33	S 0 52	S 1 54	
Netherwood		D 18 20		D 18 35		D 19 02	S 19 23	S 19 53	S 20 42	S 21 38	S 22 39	S 23 36	S 0 55	S 1 57	
Plainfield	D 17 59	D 18 23		D 18 38	D 18 46	D 19 05	S 19 26	S 19 56	S 20 45	S 21 41	S 22 42	S 23 39	S 0 58	S 1 59	
Dunellen	D 18 04	D 18 28		D 18 43	D 18 52	D 19 10	S 19 31	S 20 01	S 20 50	S 21 46	S 22 46	S 23 44	S 1 03	S 2 04	
Bound Brook	D 18 10	D 18 34		D 18 49	D 18 58	D 19 16	S 19 36	S 20 06	S 20 55	S 21 52	S 22 52	S 23 50	S 1 08	S 2 09	
Bridgewater	D 18 14	D 18 37		D 18 52	D 19 01	D 19 19	D 19 39	S 20 09	D 20 58	S 21 54	D 22 55	S 23 52	D 1 10	D 2 12	
Somerville	D 18 19	D 18 42		D 18 57	D 19 06	D 19 24	D 19 44	S 20 14	D 21 03	S 21 59	D 23 00	S 23 57	D 1 15	D 2 16	
RARITAN	D 18 22	S 18 48	S 18 34	S 19 04	D 19 09	D 19 31	S 19 51	S 20 17	s 21 10	S 22 02	S 23 07	S 0 00	S 1 22	S 2 23	

Table 57 – Future Operating Plans - Scenario 4 – Eastbound

EASTBOUND AM															
TRAINS	5404	2406	5408	5710	5900	5416	5714	5902	5420	5904	5716	5422	5718	5906	5426
Departing from:															
RARITAN	S 4 46	S 5 09	S 5 54	S 6 21		S 6 26	S 6 43		S 6 52	7 01	S 7 07	S 7 14	S 7 29		S 7 38
Somerville	S 4 49	S 5 12	S 5 57	S 6 24		S 6 29	S 6 46		S 6 55	...	S 7 10	S 7 17	S 7 32		S 7 41
Bridgewater	S 4 53	S 5 17	S 6 01	...		S 6 34	S 6 51		...	...	S 7 15	...	S 7 37		...
Bound Brook	S 4 56	S 5 19	S 6 04	S 6 30		S 6 37	S 6 54		S 7 01	...	S 7 18	S 7 23	S 7 40		S 7 47
Dunellen	S 5 01	S 5 25	S 6 10	S 6 36		S 6 43	...		S 7 07	...	...	S 7 29	...		S 7 53
Plainfield	S 5 06	S 5 30	S 6 15	...		S 6 48	...		S 7 12	...	...	S 7 34	...		S 7 58
Netherwood	S 5 09	S 5 32	S 6 18	...		S 6 51	...		S 7 15	...	...	S 7 37	...		S 8 01
Fanwood	S 5 12	S 5 36	S 6 21	...		S 6 54	...		S 7 18	...	...	S 7 41	...		S 8 04
Westfield	S 5 16	S 5 40	S 6 26	...	S 6 48	S 6 59	...	S 7 10	S 7 23	S 7 34	...	S 7 45	...	S 7 56	S 8 09
Garwood	...	S 5 43	S 6 29	...	...	...	...	S 7 13	...	...	...	...	...	S 7 59	...
Cranford	S 5 20	S 5 46	S 6 33	...	S 6 52	...	...	S 7 16	...	S 7 38	...	...	...	S 8 02	...
Roselle Park	S 5 25	S 5 52	S 6 38	...	S 6 58	...	...	S 7 22	...	S 7 44	...	...	...	S 8 08	...
Union	S 5 29	S 5 56	S 6 42	...	S 7 02	...	...	S 7 26	...	S 7 48	...	...	...	S 8 12	...
NEWARK PENN STATION	5 41	S 6 08	6 55	S 7 02	S 7 14	S 7 19	S 7 24	S 7 38	S 7 43	S 8 00	S 7 48	S 8 05	S 8 10	S 8 24	S 8 29

EASTBOUND AM										PM					
TRAINS	5720	5908	5600	5724	5428	5730	5432	XR22	5434	5736	XR24	5438	XR26	5440	5742
Departing from:															
RARITAN	S 7 53			S 8 13	S 8 45	S 9 49	S 10 49		S 11 49	S 12 48		S 1 49		S 2 49	S 3 37
Somerville	S 7 56			S 8 16	S 8 48	S 9 52	S 10 52		S 11 52	S 12 51		S 1 52		S 2 52	S 3 40
Bridgewater	S 8 01			S 8 21	S 8 52	S 9 56	S 10 56		S 11 56	S 12 55		S 1 56		S 2 56	S 3 45
Bound Brook	S 8 04		S 8 08	S 8 24	S 8 55	S 9 59	S 10 59		S 11 59	S 12 58		S 1 59		S 2 59	S 3 48
Dunellen	...		S 8 14	...	S 9 02	S 10 06	S 11 06		S 12 06	S 1 05		S 2 06		S 3 06	S 3 55
Plainfield	...		S 8 19	...	S 9 06	S 10 11	S 11 12		S 12 12	S 1 11		S 2 12		S 3 12	S 4 00
Netherwood	...		S 8 22	...	S 9 09	S 10 14	S 11 15		S 12 15	S 1 14		S 2 15		S 3 15	S 4 03
Fanwood	...		S 8 25	...	S 9 12	S 10 17	S 11 19		S 12 19	S 1 18		S 2 19		S 3 19	S 4 06
Westfield	...	S 8 20	S 8 30	...	S 9 17	S 10 22	S 11 25		S 12 25	S 1 23		S 2 25		S 3 25	S 4 10
Garwood	...	...	...	...	S 9 20	...	...		...	S 1 26		...		...	S 4 13
Cranford	...	S 8 24	...	...	S 9 23	S 10 26	S 11 29		S 12 29	S 1 29		S 2 29		S 3 29	S 4 16
Roselle Park	...	S 8 30	...	...	S 9 29	S 10 31	S 11 34		S 12 34	S 1 34		S 2 34		S 3 34	S 4 22
Union	...	S 8 34	...	...	S 9 33	S 10 35	S 11 38		S 12 38	S 1 38		S 2 38		S 3 38	S 4 25
NEWARK PENN STATION	S 8 34	S 8 45	S 8 50	S 8 55	S 9 46	S 10 47	S 11 50		S 12 50	S 1 50		S 2 50		S 3 50	S 4 40

Table 57 – Future Operating Plans - Scenario 4 – Eastbound

EASTBOUND	PM														
TRAINS	5444	X540	X542	X560	X544	5746	X546	5448	X570	X548	X590	5450	X572	X574	X576
Departing from:															
RARITAN	S 4 10					S 5 12		S 5 36				S 6 37			
Somerville	S 4 13					S 5 15		S 5 39				S 6 40			
Bridgewater	S 4 18					S 5 19		S 5 44				S 6 44			
Bound Brook	S 4 21			E 5 19		S 5 22		S 5 47				S 6 47			
Dunellen	S 4 27			…		S 5 28		S 5 52				S 6 53			
Plainfield	S 4 32			…		S 5 33		S 5 57				S 6 57			
Netherwood	S 4 34			…		S 5 35		S 6 00				S 7 00			
Fanwood	S 4 38			…		S 5 38		S 6 03				S 7 03			
Westfield	S 4 42	E 4 55	E 5 15	…	E 5 39	S 5 43	E 6 03	S 6 07		E 6 28	E 6 54	S 7 07			
Garwood	S 4 45	…	…	…	…	S 5 46	…	…		…	…	…			
Cranford	S 4 48	…	…	…	…	S 5 49	…	S 6 11		…	…	S 7 11			
Roselle Park	S 4 53	…	…	…	…	S 5 55	…	S 6 17		…	…	S 7 16			
Union	S 4 57	…	…	…	…	S 5 59	…	S 6 20		…	…	S 7 20			
NEWARK PENN STATION	S 5 09	…	…	…	…	S 6 09	…	S 6 32		…	…	S 7 35			

EASTBOUND	PM														
TRAINS	5910	X578	5452	X580	X582	X584	5454	5732	X586	5458					
Departing from:															
RARITAN			S 8 04				S 9 50	S 10 49		S 11 40					
Somerville			S 8 07				S 9 53	S 10 52		S 11 43					
Bridgewater			S 8 11				S 9 57	S 10 56		S 11 47					
Bound Brook			S 8 14				S 10 00	S 10 59		S 11 50					
Dunellen			S 8 20				S 10 06	S 11 06		S 11 56					
Plainfield			S 8 25				S 10 11	S 11 11		S 12 01					
Netherwood			S 8 27				S 10 13	S 11 14		S 12 03					
Fanwood			S 8 30				S 10 16	S 11 17		S 12 06					
Westfield	S 7 45		S 8 35				S 10 21	S 11 22		S 12 11					
Garwood	…		…				…	…		…					
Cranford	S 7 49		S 8 39				S 10 25	S 11 26		S 12 15					
Roselle Park	S 7 55		S 8 44				S 10 30	S 11 31		S 12 20					
Union	S 7 59		S 8 48				S 10 34	S 11 35		S 12 24					
NEWARK PENN STATION	S 8 10		S 9 01				A 10 47	S 11 47		A 12 38					

Table 58 – Future Operating Plans - Scenario 4 – Westbound

WESTBOUND AM															
TRAINS	5401	5403	X573	X575	X577	X579	X581	5409	X595	X585	5711	X587	X593	X589	X597
Departing from:															
NEWARK PENN STATION	LV 12 29	LV 1 29						LV 6 06	…	…	LV 7 09	…	…	…	…
Union	S 12 37	S 1 37						S 6 14	…	…	S 7 17	…	…	…	…
Roselle Park	S 12 40	S 1 40						S 6 17	…	…	S 7 20	…	…	…	…
Cranford	S 12 45	S 1 45						S 6 22	…	…	S 7 25	…	…	…	…
Garwood	…	S 1 47						S 6 24	…	…	S 7 28	…	…	…	…
Westfield	S 12 48	S 1 50						S 6 27	A 6 32	A 6 55	S 7 31	A 7 37	…	…	A 8 05
Fanwood	S 12 52	S 1 54						S 6 32			S 7 35		…	…	
Netherwood	S 12 55	S 1 57						S 6 35			S 7 38		…	…	
Plainfield	S 12 58	S 1 59						S 6 38			S 7 41		…	…	
Dunellen	S 1 03	S 2 04						S 6 42			S 7 46		…	…	
Bound Brook	S 1 08	S 2 09						S 6 48			S 7 52		A 7 56	…	
Bridgewater	L 1 10	L 2 12						L 6 51			S 7 54			…	
Somerville	L 1 15	L 2 16						L 6 56			S 7 59			…	
RARITAN	S 1 26	S 2 32						S 7 00			S 8 02			8 08	

WESTBOUND AM							PM								
TRAINS	5413	5415	XR21	5719	5421	5423	XR23	XR25	5725	5427	5729	5429	5901	5731	5431
Departing from:															
NEWARK PENN STATION	LV 8 00	LV 9 07		LV 10 07	LV 11 07	LV 12 07			LV 1 07	LV 2 07	LV 3 07	LV 3 55	LV 4 10	LV 4.24	LV 4.29
Union	S 8 09	S 9 15		S 10 15	S 11 15	S 12 15			S 1 15	S 2 15	S 3 15	L 4 02	L 4 20	…	…
Roselle Park	S 8 12	S 9 18		S 10 18	S 11 18	S 12 18			S 1 18	S 2 18	S 3 18	L 4 06	L 4 24	…	…
Cranford	S 8 17	S 9 23		S 10 23	S 11 23	S 12 23			S 1 23	S 2 23	S 3 23	L 4 11	L 4 29	…	…
Garwood	S 8 19	…		S 10 26	…	…			…	S 2 26	S 3 26	L 4 13	…	…	…
Westfield	S 8 23	S 9 27		S 10 29	S 11 27	S 12 27			S 1 27	S 2 29	S 3 29	L 4 17	A 4 33	…	L 4.44
Fanwood	S 8 27	S 9 31		S 10 33	S 11 31	S 12 31			S 1 31	S 2 33	S 3 33	L 4 22		…	L 4.49
Netherwood	S 8 30	S 9 34		S 10 36	S 11 34	S 12 34			S 1 34	S 2 36	S 3 36	L 4 25		…	L 4.52
Plainfield	S 8 33	S 9 37		S 10 39	S 11 37	S 12 37			S 1 37	S 2 39	S 3 39	L 4 28		…	L 4.55
Dunellen	S 8 38	S 9 42		S 10 44	S 11 42	S 12 42			S 1 42	S 2 44	S 3 44	L 4 33		…	L 5.00
Bound Brook	S 8 44	S 9 49		S 10 51	S 11 49	S 12 49			S 1 48	S 2 51	S 3 50	L 4 39		L 4.49	A 5.05
Bridgewater	L 8 47	L 9 51		L 10 53	L 11 51	L 12 51			S 1 51	L 2 53	S 3 52	L 4 42		L 4.51	
Somerville	L 8 52	L 9 56		L 10 58	L 11 56	L 12 56			S 1 56	L 2 58	S 3 57	L 4 47		L 4.56	
RARITAN	S 9 10	S 10 15		L 11 01	S 12 13	S 1 14			S 1 59	S 3 14	S 4 00	S 4 53		L 4.59	

Table 58 – Future Operating Plans - Scenario 4 – Westbound

WESTBOUND PM															
TRAINS	5903	5733	5435	5905	5735	5437	5907	5737	5439	5909	5739	5441	5911	5741	5445
Departing from:															
NEWARK PENN STATION	LV 4.34	LV 4.50	LV 4.55	LV 5.00	LV 5.14	LV 5.19	LV 5.24	LV 5.40	LV 5.45	LV 5.50	LV 6.04	LV 6.09	LV 6.14	LV 6.30	LV 6.35
Union	L 4.44	…	…	L 5.10	…	…	L 5.34	…	…	L 6.00	…	…	L 6.24	…	…
Roselle Park	L 4.48	…	…	L 5.14	…	…	L 5.38	…	…	L 6.04	…	…	L 6.28	…	…
Cranford	L 4.53	…	…	L 5.19	…	…	L 5.43	…	…	L 6.09	…	…	L 6.33	…	…
Garwood	L 4.55	…	…	…	…	…	L 5.45	…	…	…	…	…	L 6.35	…	…
Westfield	A 4.59	…	L 5.11	A 5.23	…	L 5.35	A 5.49	…	L 6.01	A 6.13	…	L 6.25	A 6.39	…	L 6.51
Fanwood		…	L 5.16		…	L 5.40		…	L 6.05		…	L 6.29		…	L 6.55
Netherwood		…	L 5.19		…	L 5.43		…	L 6.09		…	L 6.33		…	L 6.59
Plainfield		…	L 5.22		…	L 5.46		…	L 6.12		…	L 6.36		…	L 7.02
Dunellen		…	L 5.27		…	L 5.51		…	L 6.17		…	L 6.41		…	L 7.07
Bound Brook		L 5.15	L 5.33		L 5.39	L 5.57		L 6.05	L 6.23		L 6.29	L 6.47		L 6.55	L 7.13
Bridgewater		L 5.18	…		L 5.42	…		L 6.08	…		L 6.32	…		L 6.58	…
Somerville		L 5.24	L 5.38		L 5.47	L 6.02		L 6.14	L 6.28		L 6.38	L 6.53		L 7.04	L 7.19
RARITAN		L 5.27	L 5.41		L 5.50	L 6.05		L 6.17	L 6.31		L 6.41	S 6.56		L 7.07	S 7.21

WESTBOUND PM															
TRAINS	5913	5743	5447	5749	5451	5753	5455	5757							
Departing from:															
NEWARK PENN STATION	LV 6.40	LV 6.54	LV 7.01	LV 7.30	LV 8.13	LV 9.09	LV 10.09	LV 11.09							
Union	L 6.50	…	L 7.10	S 7.38	S 8.21	S 9.17	S 10.17	S 11.17							
Roselle Park	L 6.54	…	L 7.14	S 7.42	S 8.24	S 9.21	S 10.20	S 11.20							
Cranford	L 6.59	…	L 7.19	S 7.46	S 8.29	S 9.25	S 10.25	S 11.25							
Garwood	…	…	L 7.22	…	S 8.31	S 9.28	S 10.28	…							
Westfield	A 7.03	…	L 7.25	S 7.50	S 8.35	S 9.31	S 10.31	S 11.29							
Fanwood		…	L 7.30	S 7.55	S 8.39	S 9.35	S 10.35	S 11.33							
Netherwood		…	L 7.33	S 7.58	S 8.42	S 9.38	S 10.39	S 11.36							
Plainfield		…	L 7.36	S 8.01	S 8.45	S 9.41	S 10.42	S 11.39							
Dunellen		…	L 7.41	S 8.06	S 8.50	S 9.46	S 10.46	S 11.44							
Bound Brook		L 7.19	L 7.46	S 8.11	S 8.55	S 9.52	S 10.52	S 11.50							
Bridgewater		L 7.22	L 7.49	S 8.14	L 8.58	S 9.54	L 10.55	S 11.52							
Somerville		L 7.28	L 7.54	S 8.19	L 9.03	S 9.59	L 11.00	S 11.57							
RARITAN		L 7.31	S 8.00	S 8.22	S 9.10	S 10.02	S 11.07	S 12.00							